JULY, 1934.

GENERAL PHYSICS.

ADSORPTION.

2672. Volumetric Determination of the Density of Air Adsorbed by Powders. M. W. Tschapek. *Kolloid Zeits.* 67. *pp.* 145–148, *May,* 1934.—A method is described for measuring the density of air adsorbed by powders. F. J. W.

2673. Tenacity of Active Carbons for Vapours. Parts II and III. F. Krczil and H. Wejroch. *Kolloid Zeits.* 67. *pp.* 161–163 *&* 163–167, *May,* 1934.—The amount of vapour retained by a vapour-charged carbon after a current of an indifferent gas has been passing for a definite period is greater for low than for high gas-velocity, but the amount retained after a definite quantity of the gas has passed is independent of its velocity. The amount of benzene taken up by a zinc chloride carbon, and also the amount retained after air has been passed for a definite time over the carbon, are independent of the size of the granules for sizes up to about 1·5 mm. For larger granules, the amounts retained are smaller during the early stages of the expulsion but greater during the later stages than those observed with smaller granules after corresponding periods. [For Part I see Abstract 1372 (1934)]. T. H. P.

2674. Adsorption of Vapours by Activated Charcoal. Part IV. J. N. Pearce and J. F. Eversole. *J. Phys. Chem.* 38. *pp.* 383–393, *March,* 1934.—The present paper records the results obtained by studying how the adsorption of the vapours of ethylene chloride, ethylidene chloride, propylene chloride and trimethylene chloride on charcoal varies at temperatures between 0° C. and 136° C. It is shown that within the pressure range employed, the adsorption magnitudes are satisfactorily expressed by the simple Langmuir equation for adsorption on plane surfaces. It is also shown that the Freundlich equation does not hold for any of the vapours. [For Part III see Abstract 2820 (1931).] J. K.

2675. Adsorption of Electrolytes at Heteropolar Crystalline Surfaces. D. Balarew and A. Koluschewa. *Kolloid Zeits.* 67. *pp.* 203–207, *May,* 1934.—The extent of occlusion of several electrolytes by $BaSO_4$ precipitates has been determined and taken as a measure of their ease of adsorption by a $BaSO_4$ surface. The results do not agree with the adsorption series of Težak and it is suggested that the structure of the adsorption layer is rather more complicated than has been thought hitherto. F. J. W.

ATOMIC AND MOLECULAR STRUCTURE.

2676. Properties of the Nucleus. G. C. Wick. *N. Cimento,* 11. *pp.* 227–234, *April,* 1934.—The exchange interaction between a neutron and a proton is assumed to be of the form ae^{-br}. Using statistical methods as introduced by Heisenberg and by Majorana [see Abstracts 1842 (1933) and 2923 (1933)], the values of the constants a and b are deduced from the mass of the heavy isotope of hydrogen and the effective cross-section of protons for neutrons. None of the experimental values is known with certainty; the mass 1·0078 is adopted for the neutron. The results are used to deduce the ratio Z/N of the number of protons to the number of neutrons in a nucleus. For Z + N = 200, the value of Z/N is 1·36; the experimental value is about 1·5. F. C. C.

2677. Nuclear Constitution. G. Gamow. *Nature,* 133. *pp.* 744–747, *May* 19, 1934.—The author discusses Heisenberg's theory and the manner in which it accounts for the main features of nuclear stability. Recent theories to explain the processes of the emission of α-particles and electrons and the connection of the disintegration energy with the average life period are also discussed. W. E. P.

2678. Methods of Isolating Heavy Water. G. Bruni and M. Strada. *Accad. Lincei, Atti.* 19. *pp.* 453–458, *April* 8, 1934.—The methods discussed are: (1) Fractional crystallisation of water, (2) Fractional crystallisation of hydrated salts. By method (1) the content of heavy water has been raised from 0·2 to 4·14 per thousand, and from KOH solution which has been in continuous use for more than 5 years in an electrolytic plant, water containing 6·27 parts of D_2O per 1000 has been obtained by repeated distillations and freezings. Water derived from snow which has been repeatedly thawed and frozen, and that from alpine glaciers is also being examined. By method (2) water containing up to 4·12 parts of D_2O per 1000 has been separated from natural carnallite crystals. T. H.P.

2679. Electrolytic Production of Heavy Water. K. Schwarz, L. Küchler and H. Steiner. *Zeits. f. Elektrochen.* 40. *pp.* 298–299, *June,* 1934.—A relatively simple apparatus was employed, consisting of 60 long test tubes carried on a frame and immersed in an accumulator vessel through which cooling water was circulated. The electrodes consisted of iron wire, and the electrolyte was 0·8 *N* NaOH solution. A number of such units were placed in series and a current of 3–4 amperes at 220 V was passed through the cells, and the temperature maintained below 18° C. In this way about 15 l. of water were treated daily, and after concentration and distillation yielded 2 l. of water, containing 0·12 % of heavy water. F. J. B.

2680. Natural Separation of the Isotopes of Hydrogen. Part I. M. Dole. *J. Chem. Phys.* 2. *pp.* 337–341, *June,* 1934.—Waters obtained in the combustion of benzene, kerosene and honey have been analysed for their H^2 content by density measurements. In all cases the concentration is greater in these substances than it is in distilled water from Lake Michigan. AUTHOR.

2681. Continuous Flow Methods of Concentrating H^2. L. C. Anderson, J. O. Halford and J. R. Bates. *J. Chem. Phys.* 2. *pp.* 342–344, *June,* 1934.—Experimental arrangements for the concentration of H^2 by electrolysis in a continuous flow system are described. These are found to be as efficient as straight electrolysis in single cells and involve considerably less manual labour. An arrangement for the recovery of hydrogen of high H^2 content which is practically free from danger of explosion is also given. AUTHOR.

2682. Isotopic Masses from Band Spectra. R. de L. Kronig. *Physica,* 1. *pp.* 617–622, *May,* 1934. *In English.*—It is shown why the customary method of determining the mass of an isotope from band spectrum data may lead to an incorrect value of this quantity. AUTHOR.

2683. Neutrons. G. Alocco. *N. Cimento,* 11. *pp.* 245–254, *April,* 1934.—A review of recent experiments in connection with the neutron, including descriptions of the mode of emission of neutrons from matter, nuclear transmutations, and theoretical researches which tend to explain the nature and the function of the neutron in the nucleus. J. J. S.

2684. Emission and Scattering of Neutrons. J. R. Dunning. *Phys. Rev.* 45. *pp.* 586–600, *May* 1, 1934.—The author has examined the neutrons emitted from Be when bombarded by Rn α-particles, a number of groups being found. The origin of these groups is discussed and certain transitions involving possibly two resonance levels are suggested in explanation. The neutron mass is deduced as being 1·0068. The interaction between neutrons and other nuclei has also been studied and it is deduced that the effective volume of the nucleus in collisions is proportional to its atomic weight. The radius of the neutron is calculated as being $1{\cdot}2 \times 10^{-13}$ cm., the nuclear radii appearing to vary between $2{\cdot}5 \times 10^{-13}$ for Li and $7{\cdot}8 \times 10^{-13}$ for lead. J. E. R. C.

2685. Mass of the Neutron. Irène Curie and F. Joliot. *Nature,* 133. *p.* 721, *May* 12, 1934.—Chadwick bases his figure (1·0068) for the mass of the neutron upon the assumption that when boron is bombarded with α-particles neutrons are emitted according to the equation :— ${}^{11}{}_{5}\mathrm{B} + {}^{4}{}_{2}\mathrm{He} = {}^{14}{}_{7}\mathrm{N} + {}^{1}{}_{0}\mathrm{n}$. Experiments made by the authors indicate that the reaction responsible for the neutrons is really ${}^{10}{}_{5}\mathrm{B} + {}^{4}{}_{2}\mathrm{He} = {}^{13}{}_{6}\mathrm{C} + {}^{1}{}_{0}\mathrm{n} + {}^{+}\epsilon$. This reaction is an alternative to that in which ${}^{10}{}_{5}\mathrm{B}$ disintegrates with the emission of a proton and from measurements of the energy of the emitted proton and measurements of the energies of the emitted neutron and positron it is possible to make an estimate of the mass of the neutron without using the exact masses of any nucleus except the proton. The mass obtained in this way is $1{\cdot}010 \pm 0{\cdot}0005$. Other reactions, viz., the disintegration of Mg and Al give values which are in accordance with this. J. E. R. C.

2686. Quantum Theory of the Neutron. G. Temple. *Roy. Soc., Proc.* 145. *pp.* 344–358, *June* 2, 1934.—A theory of the neutron is developed on the basis of the second order Dirac wave equation for the H-atom. It is shown that this equation possesses two types of solutions, the type " H " which yields the accepted wave functions of the H-atom, and the type " N " which is identified with the wave function of the neutron. The following properties of the neutron are deduced from the form of the " N " solutions. (1) The energy spectrum of the neutron covers the interval $- m_0c^2 \leqslant E > + m_0c^2$, the energy of the normal state being $- m_0c^2$, and its binding energy relative to the normal H-atom being, approximately, $2m_0c^2$ or 10^6 electron volts. (2) For every energy level of the neutron $l = 0$ and $j = \frac{1}{2}$; hence the normal state of the H-atom is really a metastable state from which no transitions can occur to the neutron states. (3) The average value of r, the electron-proton distance in the normal neutron is $3a_0/10$, where a_0 is the radius of the first Bohr orbit of H. The average value of r^{-1} is $6/\alpha^2a_0$ where α is the fine structure constant. (4) An expression is deduced for the external field of the normal neutron. N. M. B.

2687. Genealogy of Atomic Nuclei. C. Hoenig. *Helv. Phys. Acta,* 7. 4. *pp.* 459–461, 1934. *In German.*—Under certain hypotheses the nuclei of the elements of the periodic system show a genealogical development in the property of spatial form. The conclusions are illustrated by means of a diagram. J. E. K.

2688. Periodic Law and its Interpretation. (Lord) Rutherford. *Chem. Soc., J. pp.* 635–642, *May,* 1934. *Mendeléef Centenary Lecture.*—After an outline of the empirical development of the periodic table, the influence of the discovery of the electron and X-ray spectral analysis, and the work of Bohr and Moseley are reviewed, leading to the discovery of isotopes, their structure and distribution, and their explanation on the nuclear theory. The use of energy changes in nuclear transformations as a means of determining nuclear masses, and the recent discovery of unstable atoms by Curie and Joliot are noted. The explanation, by Bohr and his collaborators, of the periodic properties of the elements and of their complex light and X-ray spectra under different conditions of excitation is pronounced one of the most notable advances of the century. The lecture concludes with observations on wave mechanics, the theoretical necessity of the inert gases and the transition and rare-earth elements, the quantum theory of valency and the structure of the atomic nucleus. N. M. B.

2689. " Unshared " Electrons and the Effects Produced by o-p-Directive Substituents in Organic Molecules. G. N. Burkhardt and M. G. Evans. *Manchester Phil. Soc., Mem.* 77. *pp.* 37–50, 1932–1933. —The properties of the so-called " unshared " electrons of such atoms as trivalent nitrogen, divalent oxygen and monovalent halogen are dealt with from the standpoint of recent changes in the theory of interatomic linkages. Quantitative, conjugative, tautomeric, electromeric, and primary interior effects are discussed at length, particularly in connection with substitution in benzene derivatives, dissociation constants, and rates of reaction involving groups attached to benzene. The molecule is treated as a set of nuclei to which the appropriate number of electrons are added, whereby they fall into their lowest possible energy levels, some of which may be associated with the nuclei and others with the molecule as a whole, thereby building up a set of molecular electronic levels. The electrons are discussed in three classes: bonding, antibonding, and non-bonding. As the atoms become more complex, there is a tendency for the inner shells of electrons to remain associated with the nuclei, while the outer electronic shells become thoroughly shared and molecular. It does not appear to be possible at present to decide how great a part is played in orientation and other velocity phenomena by true electromeric effects, on the one hand, and by statistically permanent effects on the other, but the authors stress the importance of the latter. H. H. Ho.

2690. Structure of the Molecule of Nitrogen Dioxide from a Study of its Infra-Red Absorption Spectrum. G. B. B. M. Sutherland. *Roy. Soc., Proc.* 145. *pp.* 278–287, *June* 2, 1934.—An account is given of new experimental work on the infra-red absorption spectrum of nitrogen dioxide under high dispersion. The present data on the infra-red absorption spectrum of this molecule are then critically analysed and shown to lead inevitably to the conclusion that the form of the molecule is triangular and not linear as has been suggested by some of the other observers. The fundamental frequencies of the molecule have the values 641 cm.^{-1}, 1373 cm.^{-1} and 1615 cm.^{-1}. The contours of the infra-red bands indicate that the angle between the NO bonds is somewhat less than 58°, and a possible electronic configuration for such a ring structure is proposed. AUTHOR.

2691. Linkage of CO_2 and CO. H. Lessheim and R. Samuel. *Phys. Soc., Proc.* 46. *pp.* 523–530, *July* 1, 1934.—New calculations of Adel and Dennison [see Abstract 4102 (1933)] make it possible to show that the ground level of CO_2 arises adiabatically from $C(p^4\ {}^3P) + O\ ({}^3P) + O\ ({}^3P)$, or in other words that the linkage of the carbon atom to either of the oxygen atoms is exactly the same and is due to a pronounced $p^2 = p^4$ bond (O = C = O). Excitation in the ground level of the CO molecule of those two electrons which in the adiabatic dissociation become the s^2 group of carbon in such a way that in the dissociation they become two additional p electrons, brings about the carbonyl term of CO. Adiabatic dissociation of CO_2 into CO and O leads to the carbonyl term (= C = O) and an unexcited O. The linkage in CO has to be considered as a double link. The numerical agreement is very good. AUTHORS.

2692. Existence of O_4 in Liquid Oxygen. Guillien. *Comptes Rendus*, 198. *pp.* 1486–1488, *April* 23, 1934.—An investigation of the absorption spectrum of liquid oxygen in the range 3600–11,000 Å shows that the absorption maxima vary similarly for 5769, 5325, and 4773 Å, but in a different manner for 7630 Å, the absorbing molecule not being the same in the two cases. The three first-named bands in the visible and ultra-violet are regarded as due to the O_4 molecule. This conclusion is supported by application of the law of mass action to compressed oxygen and to oxygen-nitrogen mixtures, and by the classification of the band systems. N. M. B.

See also Abstracts 2695, 2697, 2713, 2727, 2728, 2823, 2825, 2826, 2897, 2911, 2912, 2914, 2933, 2946, 2958, 2983, 2985, 2992, 3026, 3037, 3060.

COLLOIDS.

2693. Equations of Streaming Potential and Electroendosmosis. S. Komagata. *Electrot. Laborat. Tokyo, Japan, Researches, No.* 361. [49 *pp.*], 1934. *In English.*—Mathematical treatment of streaming potentials suggests modifications of the Helmholtz equation and explains previously observed deviations from it. A. S. C. L.

2694. Electrical Properties of Colloidal Solutions. Part IV. Difference in Properties between Colloidal Acid Solutions and Acids in True Solution. I. Mukherjee. *Kolloid Zeits.* 67. *pp.* 178–186, *May*, 1934.—Colloidal solutions of substances shown to be feebly acidic by electrochemical data behave in many respects like very strong acids, and exhibit properties not in accord with the behaviour of acids in true solution. Changes in the specific surface must be considered in order to explain the observed increase in the total concentration of neutralisable acid. Various curves obtained show the peculiarities of the variation of the H-ion concentration with the dilution. Knowledge of the active concentration of neutralisable acid is required to explain titration curves or calculate the degree or constant of dissociation; the duration of the reciprocal action may also influence the equilibrium conditions. The usual thermodynamic assumptions are not applicable, without modification, to such colloidal solutions. OH-ions may disappear by chemical combination with anhydride molecules. [For Part III see Abstract 4727 (1933).] T. H. P.

2695. Diffusion of Colloids and Colloidal Electrolytes. Egg Albumin. Comparison with Ultracentrifuge. J. W. McBain, C. R. Dawson and H. A. Barker. *Am. Chem. Soc., J.* 56. *pp.* 1021–1027, *May*, 1934.—Under suitable conditions (discussed in the paper), diffusion through porous membranes of constant properties is found to be one of the simplest, quickest and most accurate methods of determining particle size or molecular weight of molecules larger than sucrose that are approximately spherical. Only at the isoelectric point or, with less certainty, in the presence of buffers is the true molecular weight obtained, and 34,000 has been found for egg albumin. At other values of pH or with insufficient or unsuitable buffering, widely divergent values result from the phenomena of the mutual acceleration and retardation of ions and charged particles. Thus charged colloids may be found to diffuse faster than ordinary molecules. H. H. Ho.

2696. Kinetics of Coagulation. N. V. Karekar and A. M. Patel. *Faraday Soc., Trans.* 30. *pp.* 493–496, *June*, 1934.—The coagulation of thorium hydroxide hydrosols by electrolytes has been observed with special reference to the autocatalytic rate observed by other workers. It is found that the autocatalytic effect decreases with prolonged dialysis and is increased by the presence of stabilising polyvalent kations. A. S. C. L.

2697. Structure of Fatty Esters of Cellulose. J. J. Trillat. *J. de Physique et le Radium*, 5. *pp.* 207–215, *May*, 1934.—X-ray examination of the triacid fatty esters (C_2–C_{10}, C_{16} and C_{18}) of cellulose in the forms of powder and films, obtained by pressure or from solution, give results similar to those obtained with other series of saturated aliphatic derivatives. They indicate that the structure consists of a chain of β-glucose (hydropyrane) rings united to each other through O (producing the " amorphous " halo indicating 4·2–4·5 Å as the diameter of the ring), while the aliphatic ester chains are arranged ∥ to each other and ⊥ to the plane of the rings, two on one side and one on the other of a ring, giving rise in the X-ray diagrams to rings of diameter steadily increasing (by 1·3 Å per atom) with the number of C atoms in the ester chain. The CH_3 groups terminating these chains form planes of easy slip. The lower esters (C_2–C_5) are distinctly crystalline, the higher amorphous, or more correctly mesomorphous (smectic) owing to the parallelism of the ester chains, of which the influence increases with the length. The cellulosic (fibre) chains are united to each other by van der Waals forces. [See Abstract 4004 (1931).] C. A. S.

2698. Emulsification of Mercury. L. Kremnev. *Kolloid Zeits.* 67. *pp.* 171–178, *May*, 1934.—About 100 substances, tested for their emulsifying power towards mercury, form the three groups: suspensions, colloidal solutions, and molecular disperse solutions (mostly electrolytes). The suggestion is made that suspensions of oxides and certain slightly soluble salts stabilise the mercury spherules by forming solid protective skins. Emulsification by suspensions gives mostly gelatinised emulsions. Among the colloids, emulsifying action is shown by typical hydrophile or hydrated inorganic colloids, the latter only when sufficiently concentrated; here also solid protective coatings are formed. Emulsification is effected also by chlorides of metals in their more highly oxidised state, oxygen-containing compounds, and oxidising agents. Suspensions of Hg_2Cl_2 and Hg_2O are also true emulsifiers. The conditions for stabilising dilute and concentrated mercury emulsions in water are compared. T. H. P.

2699. Becher Centrifuges for Determination of Particle Sizes in Colloidal Solutions. M. Schlesinger. *Kolloid Zeits.* 67. *pp.* 135–142, *May*, 1934.—From the fact that spatial concentration differences cannot occur in simple rapid centrifuges because of intense disturbances which arise, an expression is derived whereby particle diameters may be estimated. Application of the formula is not limited to suspensions which form a compact solid sediment, but includes fine sols, and supporting data are given for a range of gold sols of 5–56 mμ. A large number of practical advantages are claimed, including the means of recognising homo- and hetero-disperse sols. H. H. Ho.

2700. Influence of an Electric Field on the Precipitation of Silver Chromate in Gelatin. M. Köhn. *Kolloid Zeits.* 67. *pp.* 207–210, *May*, 1934.—When Ag^+ and $Cr_2O_7^{--}$ ions are allowed to diffuse through gelatin under the influence of an electric field precipitation takes place in bands on both sides of a dividing line which is free from precipitate. On the kathode side the bands of precipitate are sharply defined and their number increases with increasing potential. On the anode side, the precipitate is always clearer in colour, but only shows signs of periodic precipitation at the lowest potential differences. At higher p.d. the precipitate is spongy. F. J. W.

CRYSTAL STRUCTURE AND PROPERTIES.

2701. Structure of Real Crystals. E. Orowan. *Helv. Phys. Acta*, 7. 3. *pp.* 285–297, 1934. *In German.*—Orowan replies to Zwicky [see Abstract 3297 (1933)] and maintains that theory and experiment oppose the idea of secondary structure in crystals. **Zwicky** insists that this is not the case and that his theory is supported by the experimental facts. H. L. B.

2702. Structure of $LaMg_3$, $CeMg_3$ and $PrMg_3$. A. Rossi and A. Iandelli. *Accad. Lincei, Atti*, 19. *pp.* 415–420, *March* 18. 1934.—X-ray powder photograms have been prepared for these three compounds, for their mixtures with sodium chloride, and for mixtures of $CeMg_3$ and $PrMg_3$ in equimolecular proportions. The compounds crystallise in the cubic system and the unit cell contains four molecules. T. H. P.

2703. β-Brass Transformation. H. v. Steinwehr and A. Schulze. *Phys. Zeits.* 35. *pp.* 385–397, *May* 15, 1934. *From the Reichsanstalt.*—The heat developed during the β-brass transformation has been measured together with the changes which occur in thermo-electric power, coefficient of expansion and electrical resistance. The heat developed is 3·0 cal./gm., which is of the order to be expected from an allotropic transformation. The heat is, however, not developed at one temperature as is usual with allotropic changes, but over a wide temperature range, 430°–480° C. The results do not allow any decision to be arrived at regarding the nature of this transformation, but they are in agreement with the hypothesis of Straumanis and Weerts that it is a reversible transition from an ordered to a disordered atomic distribution. F. J. W.

2704. X-Ray Crystal Measurements of Nickel at High Temperatures. W. P. Jesse. *Physics*, 5. *pp.* 147–149, *June*, 1934.—X-ray powder photographs have been made of an electrically heated nickel ribbon sealed into a thin-walled glass bulb. X-ray measurements extending from 450° to 1200° C. showed no new high temperature crystal form of nickel. The thermal expansion of the face-centred cubic lattice, present throughout the range investigated, is in agreement with macroscopic thermal expansion data. AUTHOR.

2705. Crystal State of Calcium Fluoride Films. W. G. Burgers and C. J. Dippel. *Physica*, 1. *pp.* 549–560, *May*, 1934. *In English.*—Transparent films of calcium fluoride, evaporated in a vacuum from a hot-glowing filament covered with this salt on to metal or celluloid underlayers, have been investigated by means of the method of electron-diffraction. It is shown that such films are crystalline, with random orientation of the crystallites in the first-deposited layers ; in films of 0·1 μ thickness however, a preference orientation in the outer layers has already set in, viz., with (111)-planes parallel to the substratum in the case of practically perpendicular incidence of the salt-vapour beam, and slightly inclined towards the direction of this beam in the case of strongly oblique incidence. It has been concluded from this that the films are built up of crystallites bounded by octahedral planes, the grains being more or less equiaxed in the first-deposited layers, and tending to form flat plates perpendicular to the vapour-beam and parallel to the underlayer on continued deposition of salt. This is a confirmation of the conception of the structure of these films, arrived at from adsorption-measurements by de Boer [see Abstracts 3609 (1931) and 616 (1932)]. AUTHORS.

2706. X-Ray Investigation of the System Nickel-Oxygen-Water. E. Ott and R. W. Cairns. *Zeits. f. Elektrochem.* 40. *p.* 286, *June,* 1934.—The authors re-assert the existence of the new compounds in this system, which were stated by le Blanc and Möbius to be non-existent [see Abstract 4741 (1933)]. J. T.

2707. Structures of Hydrated Lithium and Barium Compounds. C. D. West. *Zeits. f. Krist.* 88. *pp.* 198–204, *June,* 1934. *In English.*—Laue, oscillation and powder photographs are taken of $LiClO_4 \cdot 3H_2O$, $LiI \cdot 3H_2O$ and $Ba(ClO_4)_2 \cdot 3H_2O$. $LiClO_4 \cdot 3H_2O$ is hexagonal with a = 7·71 Å, c = 5·42 Å, and c/a = 0·704. There are two molecules in the unit cell. The space group is C^4_{6v}. Atomic coordinates are given. $LiI \cdot 3H_2O$ is hexagonal with a = 7·45 Å, c = 5·45 Å and c/a = 0·731 and is similar to $LiClO_4 \cdot 3H_2O$. The structure of $Ba(ClO_4)_2 \cdot 3H_2O$ is related to the other two structures examined. It is hexagonal with a = 7·28 Å, c = 9·64 Å and c/a = 1·32. There are two molecules in the unit cell. The refractive indices of the lithium salts are measured. The two salts are found to be optically similar. J. T.

2708. Crystal Lattice of Ammonium Hexafluosilicate, $(NH_4)_2SiF_6$. **B. Gossner and O. Kraus.** *Zeits. f. Krist.* 88. *pp.* 223–225, *June,* 1934.—The second (other than cubic) modification of this salt, which has been previously described as hexagonal, forms crystals of the trigonal-scalenohedral class. The lattice constants are a = 5·76 and c = 4·77 Å, and the space group D^3_{3d}. The dimorphism of the salt is peculiar in that an especially close relationship exists between the two types of lattice. T. H. P.

2709. Structure of Ammonium Beryllium Fluoride $(NH_4)_2BeF_4$. **R. Hultgren.** *Zeits. f. Krist.* 88. *pp.* 233–237, *June,* 1934. *In English.*—The orthorhombic crystal, $(NH_4)_2BeF_4$, has been investigated by the use of complete rotation and oscillation photographs. It is found that a_0 = 5·8Å, b_0 = 10·2 Å, and c_0 = 7·5 Å. The atomic arrangement is that of K_2SO_4, which structure is also assumed by $(NH_4)_2SO_4$. This shows that the BeF_4^{2-} group has much the same size and shape as the SO_4^{2-} group, which is to be expected from consideration of ionic sizes. AUTHOR.

2710. Nature and Properties of Aluminosilicate Framework Structures. W. H. Taylor. *Roy. Soc., Proc.* 145. *pp.* 80–103, *June* 2, 1934.—The structures of felspars and zeolites are based on strong frameworks of linked tetrahedral (SiO_4) and (AlO_4) groups, with kations and water molecules in the interstices. In structures hitherto described the framework forms a three-dimensionally infinite anion, but in the platy zeolites, heulandite and stilbite, it is probable (though not certain) that the framework consists of separate sheets each of finite thickness. In isomorphous replacement in the felspars divalent kations replace monovalent kations of the *same* size, the same cavities are always occupied, and valencies are balanced by alteration of the proportion of Al to Si, the replacements in orthoclase and plagioclase groups being represented by $KSi \rightleftarrows BaAl$ and $NaSi \rightleftarrows CaAl$ respectively. Similar replacements are found in zeolites, and in addition replacements such as $Ca \rightarrow Na_2$, a replacement possible when there are in the framework empty cavities which are occupied when Na replaces Ca. In base-exchange experiments with zeolites both types of replacement can be produced without destroying the crystal structure because the frameworks are penetrated by channels large enough to permit the movement of kations and water molecules. The peculiar dehydration properties of zeolites are due to these channels. In both felspars and zeolites twinning and intergrowths are frequent because the frameworks are essentially simple in structure and often possess a high *structural* symmetry to which the actual *dimensional* symmetry approximates. AUTHOR.

2711. Structure of p-Azoxyanisole. F. Würstlin. *Zeits. f. Krist.* 88. *pp.* 185–194, *June,* 1934.—An investigation of the solid phase. The space-group C_{2h}^4 is obtained, in place of C_{2h}^5 (Bernal and Crowfoot). The data require a " staggered " molecule. F. I. G. R.

2712. Structures of Hexamethylethane and Cubic Hexachlorethane. C. D. West. *Zeits. f. Krist.* 88. *pp.* 195–197, *June,* 1934. *In English.*—Above the transition temperatures $C_2(CH_3)_6$ and C_2Cl_6 have the same structure. This is cubic, with $a = 7 \cdot 69$ Å for $C_2(CH_3)_6$ and $a = 7 \cdot 43$ Å for C_2Cl_6. There are two molecules in the unit cell. The transition temperatures are – 125° C. for $C_2(CH_3)_6$ and 71° C. for C_2Cl_6. J. T.

2713. Liquid Structures by X-Ray Diffraction. G. W. Stewart. *Kolloid Zeits.* 67. *pp.* 130–135, *May,* 1934.—A review is given of work done on the diffraction of X-rays by liquids, which indicates the existence of a liquid structure possessing a certain similarity with the structure in the solid state. The limited application of the Bragg law is now extended by assumptions which enable the derivation of an expression applicable to diffraction for any angle, and a comparison is given between the theoretical and experimental results. The conclusion is drawn that a structure exists in the liquid state which is not built up of crystalline fragments, but is composed of cybotactic groups consisting of mobile molecules. The theory is claimed to be an advance on previous conceptions of solution, association, solvation, liquid crystals and electrolytes. H. H. Ho.

2714. Equilibrium of Small Crystals. Parts I and II. I. N. Stranski and R. Kaischew. *Zeits. f. phys. Chem.* 26. *Abt. B.* 1–2. *pp.* 100–113, 1934.—In Part I, the equilibrium of a finite crystal is found to be due to the equilibrium of a three-dimensional and two-dimensional embryonic vapour phase. This mode of treatment enables conclusions to be drawn which concern more especially the processes involved in the growth and solution of crystals in the embryonic stage. The theory is applied to the simple cubic lattice as an example of a homopolar crystal and to the NaCl-lattice as an example of a heteropolar crystal. In Part II the significance is discussed of the average work of separation and of the importance of the latent heat term in the vapour pressure equation for finite crystals, which latter is identified with the former quantity. H. H. Ho.

2715. Effect of a Magnetic Field on Crystallisation. E. W. R. Steacie and C. F. B. Stevens. *Canad. J. of Research,* 10. *pp.* 483–485, *May,* 1934.—An investigation has been made of the effect of a magnetic field of about 5000 gauss on the linear rate of crystallisation from supersaturated solutions of sodium thiosulphate and nickel sulphate. The field had no appreciable effect in the case of sodium thiosulphate. Nickel sulphate showed a slightly increased rate of crystallisation in the field. AUTHORS.

2716. Transition of Zirconium Crystals. W. G. Burgers. *Physica,* 1. *pp.* 561–586, *May,* 1934. *In English.*—The process of transition of the cubic-body-centred modification into the hexagonal-close-packed modification of zirconium can be described by means of a combination of shearing and dilatation processes parallel to definite crystallographic directions. The transition has, therefore, "homogeneous" or "oriented" character. AUTHOR.

2717. Structural Relations in Modification of Crystal Faces by Foreign Substances. L. Royer. *Comptes Rendus,* 198. *pp.* 1868–1870, *May* 23, 1934.—The effects now described are those of $PbCl_2$ on KCl, $PbBr_2$ on KBr, PbI_2 on KI, $HgCl_2$ on NaCl and KCl, and $AlCl_3$ on NH_4Cl [see Abstract 1417 (1934)]. T. H. P.

2718. Oriented Inclusion of Impurities in Crystals. H. E. Buckley. *Zeits. f. Krist.* 88. *pp.* 248–255, *June,* 1934. *In English.*—Impurity may adhere and become included in crystals on certain planes, whose growth rates are at the same time modified. Other methods of inclusion are described. It is shown that adhesion of impurity and modification of crystal-habit may be independent of each other. Many examples have been found where dye is heavily included on one type of face and the very strong habit-modification has occurred on entirely independent faces. AUTHOR.

2719. Perfection of Quartz and Other Crystals and Its Relation to Surface Treatment. R. M. Bozorth and F. E. Haworth. *Phys. Rev.* 45. *pp.* 821–826, *June* 1, 1934.—The perfection of various crystals has been determined by using an X-ray double crystal spectrometer. The materials examined were quartz, Rochelle salt, fluorite, tourmaline, pyrites, barite, rock-salt, gypsum, and the metallic crystals aluminium, iron, nickel, tungsten, and permalloy (65 % nickel). The results indicate that quartz is a "perfect" crystal and that specimens of Rochelle salt, fluorite and possibly tourmaline and pyrites, might be found which could be so classed. The others tested are definitely in the "imperfect" class, the widths of the rocking curves at half maximum lying between 100 and 1500 seconds of arc. The effect of surface treatment on perfection, as determined by X-rays, was examined for quartz by grinding with carborundum of two different sizes and by etching for different lengths of time. The surface of the permalloy crystal was also investigated by etching to different depths. As a result of the tests here reported, etched quartz crystals are suggested as suitable for use in the double crystal spectrometer on account of their high resolving power which is about twice that of calcite. AUTHORS.

2720. Ultramicroscopic Observations on Photosensitive Crystals. Part II. G. and K. Schaum. *Zeits. f. wiss. Phot.* 33. *pp.* 13–32, *May,* 1934.—Observations were made with a dark field condenser for thin crystals and with a Leitz Ultropak for thick crystals. The results confirm and extend those of Sheppard, Trivelli, Svedberg and Luther on the photolysis, development, fixing, etc., of halogen silver salts. Further light is thrown on the distribution of nuclei in the crystals and on the optical effect of particle size. X-rays and γ-rays produce strong photolysis in AgBr crystals but no light flaking (*Licht flockung*). The latter, however, is rapidly brought about by subsequent illumination with ordinary light. [For Part I see Abstract 4102 (1932)]. J. E.

2721. Strength of Rock-Salt Crystals. Part V. K. Wendenburg. *Zeits. f. Physik*, 88. 11–12. *pp.* 727–740, *May* 5, 1934.—Continuing previous work [see Abstracts 2279 (1932) and 1310 (1933)] the strength of very thin rock-salt crystals is shown to be independent of their diameters, for both dry and " dissolved " crystals. Deformation of a dry crystal has no definite effect on the strength of the crystal when subsequently dissolved. Variation of the rate of loading affects both kinds of crystal similarly. When a new crystal is partially dissolved in H_2O, $H_2SO_4 + 25\ \%\ SO_3$, or NH_3, dried rapidly and rested before testing, a progressive decrease of strength occurs at a rate diminishing with time of resting. The after-effects produced by different solvents proceed at different rates, and are apparently due to penetration of the solvent into the interior of the crystal. J. P. A.

2722. Elastic Moduli and Temperature Variation of the Principal Young's Modulus of Rock-Salt. L. Balamuth. *Phys. Rev.* 45. *pp.* 715–720, *May* 15, 1934.—A new method is described for measuring the elastic moduli of a homogeneous, anisotropic substance at an arbitrarily chosen temperature between 78° K and 300° K. The method is characterised by high precision and by the fact that the specimen upon which the measurement is made is small and easily prepared. Data are given which show the variation with temperature of the principal Young's modulus of rock-salt between 78° K. and 273° K. AUTHOR.

2723. Crystal Constants. V. Kunzl and J. Köppel. *J. de Physique et le Radium*, 5. *pp.* 145–151, *April*, 1934.—A more detailed account is given of the method of determining the lattice constant, depending primarily on measuring the difference between the reflection angles of different orders of the same spectral line. This is illustrated by detailed recalculations of the lattice constant of quartz (1011) by this and by Siegbahn's method, giving respectively 3336·63 and 3336·36 ± 0·06 [see Abstracts 2140 and 2158 (1933)]. Possible causes of error are discussed and that due to maladjustment shown to be much less with the new method. C. A. S.

2724. Lorenz Factor for Layer-Line Diagrams. H. Ott. *Zeits. f. Physik*, 88. 11–12. *pp.* 699–708, *May* 5, 1934.—The author's previous work on the calculation of intensities in the case of right-angled layer-line diagrams is extended to the case of oblique diagrams. Objections to the previous work are shown not to be valid and on new grounds the validity range of the earlier formula is calculated. J. T.

2725. Calculation of Intensity Factors for the Powder Method of X-Ray Crystal Analysis. F. C. Blake. *J. Chem. Phys.* 2. *pp.* 320–330, *June*, 1934.—The writer has surveyed [see Abstract 4141 (1933)] the literature as to intensity factors for the several methods of X-ray analysis. In this survey it was shown that both the atomic form factor F and the temperature factor e^{-m} properly enter into the so-called structure factor. Using the terminology of this survey one can distinguish then between the " regular " structure factor S, and what is here called the " reduced " structure factor S_0, given by SFe^{-m}. It is highly important both to the pure physicist and to the industrial physicist to be able properly to get

S_0 out of S. How this is done is illustrated in this paper both for wurtzite or α-ZnS and for sphalerite or β-ZnS. It was shown in the survey that the reason why it is necessary to operate with the reduced structure factor is on account of the phase differences between the waves diffracted by the several electrons of the *same* atom, reduced further by the levelling effect of temperature. How these levelling effects are carried out is here shown. On account of the good observational material available for wurtzite the calculations for this are shown first. AUTHOR.

2726. Electrical Migration-Velocity of Colour Centres in Alkali Halide Crystals. O. Stasiw. *Göttingen Nachrichten, Math. Phys. Klasse, No.* **4.** *pp.* **387–393, 1933.**—The substances investigated are NaCl, NaBr, KCl, KBr, KI. For high temperatures, the velocity is definite, but below a critical temperature strong velocity distribution occurs, with high values of electron velocity. The transition temperature is determined by the preponderance of the perturbation conduction.

F. I. G. R.

See also Abstracts **2678, 2697, 2915, 2932, 2933, 2945, 3023, 3024, 3025, 3036, 3039.**

DENSITY.

2727. Natural Waters of Abnormal Density. G. Vereščagin, A. Gorbov and I. Mendelejev. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 22. *pp.* 134–136, 1934. *In French.*—Gorbov in 1929 drew attention to the importance of the investigation of the variation of the density of pure water drawn from various sources. He suggested the possibility of zones of density in latitude and altitude, affecting the evolution of flora and fauna. Mendelejev suggested that in enclosed lakes, and also in the sea near to the equator, fractionation of the water by evaporation might result in a heavy residue. Samples taken at a depth of 2 km. in Lake Baïkal, after allowing for differences in chemical content, were $2{\cdot}4 \times 10^{-4}$ more dense than samples taken from the surface. This result is provisional only. The importance of the existence of heavy water in the consideration of various natural problems is indicated.

P. H. B.

2728. Micromethod for Estimation of Heavy Water. P. Goldfinger and L. Scheepers. *Comptes Rendus,* **198.** *pp.* **1916–1918,** *May* **28, 1934.**—A minute float, 3–5 mm. × 0·5–1 mm. of pyrex glass of suitable weight, is placed in the water to be tested, of which 0·1–0·2 c.c. is sufficient, and the temperature at which it just floats is determined. Tables then give the percentage of $H^2{}_2O$. C. A. S.

See also Abstracts **2672, 2680, 2880.**

DIFFUSION AND OSMOSIS.

2729. Diffusion of Vapours into Air Streams. E. R. Gilliland and T. K. Sherwood. *Indust. & Engin. Chem.* **26.** *pp.* **516–523,** *May,* **1934.**—The rates of vaporization of the following liquids, water, sec.-butyl alcohol, n-butyl alcohol, toluene, aniline, chlorobenzene, sec.-amyl alcohol, ethyl acetate and isopropyl alcohol, have been studied by allowing them to flow down the inner wall of a vertical tube through which air can be drawn at various velocities For turbulent flow it is found that the results satisfy the dimensionless equation $d/x = 0{\cdot}023(du\rho/\mu)^{0{\cdot}83}(\mu/\rho D)^{0{\cdot}44}$, where x = thickness of a stagnant gas layer which would offer the same resistance to diffusion as is actually the case; d = internal diameter of the column; u, ρ and μ = linear velocity, density and viscocisty of the gas stream, and D = diffusion coefficient for the vapour gas system. The results for laminar flow are curious in that they agree more closely with the theory which assumes the velocity across a section of the pipe to be uniform than when the true parabolic distribution is assumed. Subsidiary experiments were made to determine the two analogous quantities, the pressure drop due to friction, and the heat transfer from the walls of the tube. R. W. P.

2730. Diffusion in Metals. W. Seith, E. Hofer and H. Etzold. *Zeits. f. Elektrochem.* 40. *pp.* 322–326, *June*, 1934.—Measurements of the rates of diffusion at various temperatures up to 320° C. show that the mobility in Pb of the metals studied falls regularly in the order Au, Ag, Mg, Cd, Hg, Bi, Tl and Sn. Cd diffuses through Pb 100 times more rapidly than vice-versa, whilst Hg diffuses 3 times more rapidly through Cd than through Pb. Measurements on the diffusion of Ni in Pb and Pb in Sn are described; the results could not be evaluated owing to lack of the necessary metallographic data. H. F. G.

2731. Theory of Osmotic Pressure. K. Wohl and K. Fredenhagen. *Zeits. f. Physik*, 88. 11–12. *pp.* 800–822, *May* 5, 1934.—A reasoned refutation is first given by Wohl, of Fredenhagen's theory of osmotic pressure [see Abstract 931 (1934)], particular objection being taken to (*a*) the suggestion of intermolecular forces as the cause of the lowering of vapour pressure over a solution, and (*b*) the assumption that these forces are similar to those governing chemical reactions. In reply, Fredenhagen claims it as an accepted principle that the relation between osmotic pressure, concentration and vapour pressure cannot be deduced purely thermodynamically. All the disputed points of his theory he then reaffirms. In a counter-reply, Wohl reasserts his objections which he considers unanswered. J. P. A.

2732. Exact Thermodynamics of Membrane Equilibria. Part II. F. G. Donnan. *Zeits. f. phys. Chem.* 168. *Abt.A.* 5–6. *pp.* 369–380, 1934.—Further points [see Abstract 665 (1933)] are considered. For the sake of simplicity the compressibilities of the solutions are neglected. In most cases this causes no appreciable error. Equations for the following cases are derived: (*a*) exchange equilibria of isopolar ions, (*b*) influence of a non-diffusible non-electrolyte in the distribution of diffusible co-solutes, (*c*) electrical membrane equilibrium potentials, and (*d*) osmotic pressure. New g-coefficients, which may be regarded as mean osmotic coefficients or as mean activity indices of the ions of an electrolyte, are introduced. In the exact theory these play an important part. T. H. P.

See also Abstracts 2695, 2940, 3005.

ELASTICITY AND PLASTICITY.

2733. Bending of Loaded Plates. B. Sen. *Indian Phys. Math., J.* 5. *pp.* 17–20, *April*, 1934.—By transforming the equations to suit a general unspecified set of orthogonal coordinates, it is possible to simplify the calculation of the displacements in loaded circular and elliptical plates. J. P. A.

2734. Isotherms of Nitrogen. A. Michels, H. Wouters and J. de Boer. *Physica*, 1. *pp.* 587–594, *May*, 1934. *In English.*—The isotherms of N_2 between 0° and 150° C. and at pressures from 20 to 80 atmospheres have been determined by a similar method to that described previously [see Abstract 877 (1929)]. Modifications being made in the dimensions of the piezometer and in the method of temperature control. The results are tabulated, and values of *a* and *b* of the van der Waals equation have been derived on the assumption that they are functions of the temperature only. R. W. P.

2735. Variation of Rigidity with Frequency of Torsional Oscillation. D. Schenk. *Zeits. f. Physik*, 88. 9–10, *pp.* 626–633, *May* 2, 1934.—The values of the rigidity for Cu, Al, Ni, brass and glass, when calculated from the periods of torsional oscillations, are found to vary with the frequency. After comparision with results of experiments on fatigue, a rule is obtained from which the frequency of the oscillation determines whether or not the yield point has been surpassed. J. P. A.

2736. Faults in Material Yielding to Shear Stress with Retainment of Volume Elasticity. G. I. Taylor. *Roy. Soc., Proc.* 145. *pp.* 1–18, *June* 2, 1934.—Plastic substances may be divided into two classes according as to whether the stress increases or decreases after yielding. In the former, the effect of successive yielding of grains is to reduce internal stresses to a state of uniformity. In the latter, the yielding of successive grains might be expected to produce an increasingly heterogeneous distribution of internal stress. This distribution of stress in the neighbourhood of grains which have yielded when their boundaries are spheres or elliptic cylinders are discussed. It is shown that when each element of the material fails according to the law of v. Mises, the effect of spherical faults is to make the whole mass fail according to a law which is intermediate between that of v. Mises and Mohr. Narrow elliptical faults cause the whole mass to fail according to Mohr's law even though each element fails according to v. Mises' law. The hypotheical material considered has the property that the greatest stress concentrations occur when elongated faults lie at 45° to the directions of the principal stresses, which property seems to have its counterpart in real materials which exhibit Luder's lines. C. O. B.

2737. Discontinuous Waves Connected with Elastic Surface Vibrations. R. Einaudi. *Accad. Lincei, Atti*, 19. *pp.* 394–399, *March* 18, 1934.—The waves of discontinuity connected with the propagation of the surface vibrations of an elastic body are here discussed and it is found that there are two possible waves of discontinuity, whose velocities depend only on the values of Lamé's elastic parameters and on the density. A. J. McC.

2738. Propagation of Elastic Waves in Ice. Part I. M. Ewing, A. P. Crary and A. M. Thorne, Jr. *Physics*, 5. *pp.* 165–168, *June*, 1934.—Measurements of the velocity of sound vibrations in ice have been made in some detail both by direct and resonance methods. The velocity of longitudinal waves was measured directly on large bodies of ice. Blasting caps were used to create elastic disturbances and the time of travel was recorded by an electric seismograph placed at suitable distances. A plot of time against distance gives a remarkably straight line showing a velocity of 3410 m./sec. Laboratory measurements were made on long thin rods of ice which were excited by an oscillator and resonance frequencies measured both for longitudinal and torsional vibrations. The velocities for these vibrations are found to be 3163 m./sec. and 1913 m./sec., respectively. A formula is derived by which the velocity of longitudinal waves in a thin infinite plate can be found from these velocities. This formula gives a value of 3400 m./sec. which checks with that obtained directly by less than 1 %. Various other elastic constants for ice are also deduced from these measurements. The values of Young's modulus and Poisson's ratio for ice are found to be $9 \cdot 17 \times 10^{10}$ dynes/cm². and 0·365, respectively, in the range − 5° C. to − 15° C. AUTHORS.

2739. Bell-Type Manometer. G. Ruppel. *A.T.M.* 3. T 50–51, *April*, 1934.—The bell-type manometer is described, and formulæ are given for its operation. Some applications are described, particularly for measuring fluid flow and metering. L. E. C. H.

2740. Reflection Polariscope for Photoelastic Analysis. R. D. Mindlin. *Rev. Sci. Instruments*, 5. *pp.* 224–228, *June*, 1934.—The paper embodies the description of a polariscope which offers several advantages for photoelastic investigations and is applicable to the analysis of stress distributions in parallel plates and to Mesnager's modified three-dimensional analysis. The chief characteristic of the optical arrangement is that the light, after passing through the usual arrangement of polarising prism, retardation plate and model, is reflected directly back through the same system. AUTHOR.

See also Abstracts 2755, 2993, 3045, 3059.

HYDRODYNAMICS AND AERODYNAMICS.

2741. Intuitive Interpretation of the Curl and of the Condition of Irrotationality. F. Tricomi. *Accad. Lincei, Atti*, 19. *pp.* 399–401, *March* 18, 1934.—If small, light, thin rings are placed as exploratory bodies in a moving fluid, it is found that each ring is animated by a rotation round its centre and in its own plane of angular velocity ω equal to half the vector product of k and the curl of v, where v is the velocity vector at any point of the fluid and k is a versor normal to the plane of the ring. It follows, in particular, that if the motion is irrotational (curl $v = 0$) then the ring has no rotation round its centre. A. J. McC.

2742. Movement of an Eddy within an Area Enclosed, by Plane Boundaries. E. Paul. *Zeits. f. angew. Math. u. Mechanik* 14. *pp.* 105–116, *April*, 1934.—A mathematical treatment is given of the cases of movement in the neighbourhood of a single infinite plane wall, through an aperture in an infinite plane wall, and near a plane plate of finite extent. The cases of stationary and streaming liquid are dealt with in each instance. H. F. G.

2743. Vibration of an Infinite Cylinder in a Viscous Liquid. M. Ray. *Calcutta Math. Soc., Bull.* 25. *pp.* 121–134, *Sept.*, 1933.—A purely mathematical treatment is given of the problem of the slow vibration of an infinite circular cylinder in a viscous liquid, to which the method used by Lorentz for the case of a sphere is applied. Starting from a simple harmonic motion, the principle of superposition is found to be applicable, and solutions are given for various kinds of slow movement corresponding with Lissajous figures, *e.g.*, circular, elliptical and parabolic. H. F. G.

2744. Laminar Flow of a Viscous Fluid with Vanishing Viscosity. H. B. Squire. *Phil. Mag.* 17. *pp.* 1150–1160, *June*, 1934.—The laminar flow of a fluid of small viscosity past a circular cylinder is investigated by means of a modified boundary-layer theory. It is shown that, as the viscosity tends to zero, the motion must approximate to the discontinuous potential flow for which the free stream-line leaves the cylinder with finite curvature. It is further shown that the complete boundary-layer theory would lead to the same conclusion, which does not hold in practice owing to the instability of the laminar flow for large values of Reynolds' number. AUTHOR.

2745. Streamline and Turbulent Flow in Open Channels. J. Allen. *Phil. Mag.* 17. *pp.* 1081–1112, *June*, 1934.—The true lower critical velocity, v, of water in an open channel is given approximately by $vm/\nu = 1400$, m denoting the hydraulic mean depth at a given cross-section and ν the kinematic viscosity. This value is independent of the roughness of the walls and bed of the channel. The observed loss of head agrees very closely with the theoretical loss of head on the assumption of true laminar flow for values of vm/ν up to about 300. Then follows a range in which the flow is not turbulent; there is superposed on the laminar flow a series of tranverse currents which increases the loss of head. In the turbulent range, values of the coefficient, f, in the equation customarily employed to denote flow in an open channel are given by $f = 0{\cdot}0234(vm/\nu)^{0\cdot15}$ f.p.s. units. For a channel with smooth sides and rough bed, Bazin's formula for turbulent flow, *viz.*, $C = 157{\cdot}6/(1 + N\sqrt{m})$ foot units is reasonably accurate. The value of N is 0·195 for the roughness used in the present tests. For rough sides and rough bed the value of N in the formula is 0·225. A close approximation to the mean velocity in a vertical section is obtained by averaging the velocities at 0·2 and 0·8 of the depth. J. S. G. T.

2746. Turbulence in Flow of Air through a Pipe. H. C. H. Townend. *Roy. Soc., Proc.* 145. *pp.* 180–211, *June* 2, 1934.—Describes a method of measuring the turbulent components of the velocity in a stream of air by the production of a series of sparks which cause "hot-spots" in the air, these being photographed by the Schlieren method. Kinematograph records are analysed so as to obtain the mean speed at any point in the stream and the three deviations from the mean which are due to turbulence. Statistical values of the mean turbulence are then obtained and their relation to the maximum turbulent velocities is found. The method has been applied to the flow of air through a pipe of square section at Reynolds numbers of 3000 and 9300, and the mean turbulence has been expressed in terms of the r.m.s. values of the three components. The distribution of the turbulence was measured from the axis of the pipe to a point distant from the wall by one-tenth of the breadth. It shows a minimum near the axis and rises at an increasing rate as the wall is approached. J. W. T. W.

2747. Velocity Variations in Turbulent Flow in a Pipe. L. F. G. Simmons and C. Salter. *Roy. Soc., Proc.* 145. *pp.* 212–234, *June* 2, 1934.—Describes a new method for determining the frequency distribution and the root-mean-square of the turbulent velocities in an air stream passing through a 1 ft.-square wind tunnel both for the undisturbed state and in the wake of a grid. A hot-wire anemometer gives out-of-balance potential variations in a Wheatstone bridge circuit and these are amplified and then recorded by allowing the light from a mirror of a balanced-armature oscillograph to pass to and fro across a stationary photographic plate. After an exposure of this kind for 4 to 5 min. the plate is developed and shows a track of variable density and this, when measured with a registering microphotometer, provides a means of estimating the total equivalent time of exposure at all points along the record. From these data the velocity frequency curves can be plotted. J. W. T. W.

2748. Investigation of Turbulent Flow by Means of the Hot-Wire Anemometer. F. L. Wattendorf and A. M. Kuethe. *Physics,* 5. *pp.* 153–164, *June,* 1934.—The theory of the hot-wire anemometer, and especially of the lag in operation, is discussed, and an electrical filter which counteracts the effect of the lag is described. Determinations made with compensated apparatus of the r.m.s. value of the fluctuations in the direction of flow during turbulent flow under various conditions show that in rectilinear turbulent flow the fluctuations appear to conform to the law of mechanical similitude ; that the distribution of the fluctuations is governed by the shear stress distribution ; that in fully developed turbulent flow the r.m.s. value is independent of conditions at the entrance to the channel ; that sphere drag, the stalling point of aerofoils, etc., may be correlated with the r.m.s. fluctuation ; and that atmospheric turbulence appears to consist of large scale gusts embodying smaller scale gusts which alone influence boundary layer stability. H. F. G.

See also Abstracts 2739, 2940.

KINETIC THEORY OF MATTER.

2749. Scattering of a Beam of Potassium Atoms in Various Gases. W. H. Mais. *Phys. Rev.* 45. *pp.* 773–780, *June* 1, 1934.—A narrow beam of neutral K atoms was scattered in H_2, He, Ne, N_2, A and CO_2 at low pressures. The distribution of the scattered K atoms about the original beam was measured by the Langmuir-Taylor surface ionisation detector. The experimental conditions were sufficiently refined that K atoms suffering very small angular deviations (down to about 4·5′ of arc) were counted as scattered atoms. The computed " effective collision radii " when compared with the values expected from the quantum theory of elastic sphere collisions show good agreement for H_2 and He. For the other gases, the experimental values are much larger, indicating the existence of considerable interatomic attractive forces even for Ne and A. AUTHOR.

2750. Submicroscopic Motion of Small Particles. U. Schmieschek. *Zeits. f. techn. Physik,* 15. 5. *pp.* 178–180, 1934.—Crystals of silver, of < 0·03 mm. dia., slowly subside in a vessel of distilled water. Their vibratory movements are recorded by causing them to reflect a fine, intense pencil of light on to a photographic plate some distance away. Submicroscopic vibrations smaller in amplitude than the Brownian motions, may thus be investigated. J. P. A.

See also Abstracts 2779, 3007.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

2751. Practical Method for the Numerical Solution of Differential Equations. D. R. Hartree. *Manchester Phil. Soc., Mem.* 77. *pp.* 91–107, 1932–1933.—A rapid and easy method is described, which has been developed for the numerical integration of the differential equations concerned in the approximate calculation of atomic structures by the method of the self-consistent field, and is applicable to differential equations involving functions specified by tables, as well as to functions whose analytical form is given. It is limited to ordinary equations of the second order with the first derivative absent, of the form $d^2y/dx^2 = f(x, y)$, where

$f(x, y)$ is any smooth function of x and y, but can be easily extended to simultaneous second-order equations with the first derivatives of all variables absent. The method is based on " central differences " ; formulæ for various relations between the differences of a function, its derivatives and their differences, and various interpolation formulæ are given, and numerical examples are worked out in detail. N. M. B.

2752. Physical Units and the Universal Constants. E. U. Condon. *Am. Phys. Teacher*, 2. *pp.* 63–69, *May*, 1934.—The author first discusses existing units of mass, length and time and suggests that a practical system of units should be such that directly observed data occur in convenient magnitudes. The " ultimate rational units " of Lewis provides a system where the universal constants have conveniently small values. Hartree's system is suggested as the best in which the unit of (1) mass is that of the electron, (2) length is the radius of the Bohr orbit in hydrogen, and (3) time is that required for an electron to describe $1/2\pi$ of a revolution in the first Bohr orbit in hydrogen. Applications of these units are given in atomic physics for electrons and molecules and multiples of the units are then taken for terrestrial and astronomical magnitudes. R. S. R.

2753. Electric and Magnetic Units and Dimensions. R. T. Birge. *Am. Phys. Teacher*, 2. *pp.* 41–48, *May*, 1934.—A summary of the relations between the dimensions of the various electric and magnetic quantities, pointing out many inconsistencies in the literature of the subject. The fundamental equations for a homogeneous isotropic dielectric require three material constants, μ for the law of force between magnet poles, ϵ for that between electric charges, and k for Faraday's law of induction. The relation between wave velocity v in the dielectric and these quantities should be written $v = k/(\mu\,\epsilon)^{\frac{1}{2}}$, which for a vacuum becomes $c = k/(\mu_0\epsilon_0)^{\frac{1}{2}}$. The common practice of putting $k = c$ implies the use of the Gaussian system of units and not the electrostatic or the electromagnetic system. L. H.

2754. Giorgi (M.K.S.Ω.) System of Units. R. T. Glazebrook. *Nature*, 133. *p.* 874, *June* 9, 1934.—A correction [see Abstract 2326 (1934)].

See also Abstract 2995.

MECHANICS, CLASSICAL.

2755. Stress Calculation for Tubular Frameworks. J. B. B. Owen. *Roy. Soc., Proc.* 145. *pp.* 104–114, *June* 2, 1934.—The effects of rigid joints in frameworks can be studied by processes involving continued approximations but do not appear to have been brought within the scope of direct calculation. The present paper is intended to indicate a direction in which some advance can be made. For the calculation of primary stresses (*i.e.*, the actions which would be induced if the joints were free) Southwell [see Abstract 2165 (1933)] has recently suggested an exact method involving a synthesis of known " type-solutions," and it will sometimes be possible to take account of joint rigidity in relation to the latter. Where this can be done, an exact solution for specified loads, though laborious, will be practicable. As an example, the effects of continuous longitudinals are considered in relation to a tubular framework of the kind discussed in Southwell's paper. (This case has importance in relation to the design of rigid airship hulls, where the effects of continuity of the longitudinals is generally regarded as the main outstanding problem.) It is shown that the more important of the type-solutions will be sensibly unaffected, and that the remainder will retain their general form. In practice the corrections will usually be small, and as such can be investigated without difficulty when numerical values have been assigned to the elastic parameters. On account of the number of these, detailed discussion of the general equations is hardly worth while. AUTHOR.

2756. Periodic Oscillations of a Dynamical System. D. C. Lewis, Jr. *Accad. Lincei, Atti,* 19. *pp.* 234–237, *Feb.* 18, 1934.—It is known that there exists an infinity of periodic movements round a given periodic movement of general stable type in the case of a dynamical system of $n + 1$ degrees of freedom. Using Birkhoff's method, the present paper proves the existence of an infinity of periodic movements round a given position of equilibrium for such a dynamical system. A. J. McC.

2757. New Aspect of the Fundamental Equation of Dynamics. D. Obolensky. *Tohoku Math. J.* 39. *pp.* 6–10, *April,* 1934. *In German.* —In the case of variable mass the fundamental equation of dynamics, $P = mf$, has to be modified, and the new form is usually taken to be $P = d\,(mv)/dt$. The author writes this last equation in the form $\int P dt = m \int f dt$, and suggests that a generalisation of the fundamental law can be obtained by differentiating n times the equation $\int . .^{n}. \int P dt^{n} = m \int . .^{n}. \int f dt^{n}$, the case $n = o$ being the classical equation for constant mass and the case $n = 1$ being the classical equation for variable mass. A. J. McC.

2758. Photoelectric Cell Method of Measuring the Velocity of Projectiles. D. C. Rose. *Canad. J. of Research,* 10. *pp.* 571–587, *May,* 1934.—The velocities of rifle bullets have been measured by causing the bullet to interrupt successively beams of light shining on phtoelectric cells. The resulting current pulse in the photoelectric cells, after being amplified, actuates a recording device. Two methods of taking the records were used. In the first the amplified current from the photoelectric cells is recorded by an oscillograph consisting of an Einthoven galvanometer and a rotating drum camera. In the second method each current pulse from the amplifier caused by the interruption of the beam of light by the bullet actuates a thyratron so that it discharges a condenser. The current through the condenser is recorded by the Einthoven galvanometer. The time record for both methods is obtained from a valve-maintained tuning-fork having a frequency of 1000 ∼. The output of the tuning-fork circuit excites a second fibre in the Einthoven galvanometer. Four photoelectric cell stations were used in a range of about 150 ft. The first was placed about 23 ft. from the muzzle, the others at equal intervals down the range. The accuracy was such that in measuring velocities of about 4000 ft./sec. the probable error under the best conditions was of the order of 5 or 6 ft./sec. [See following Abstract.] AUTHOR.

2759. Thyratron as Light Source for Recording Purposes. D. C. Rose. *Canad. J. of Research,* 10. *pp.* 588–590, *May,* 1934.—Flashes of light from an FG17 thyratron have been used in conjunction with a rotating drum camera for the recording of time-intervals between phenomena. The flashes of light were obtained when a condenser was discharged through the thyratron. Time-intervals were obtained on the same record by means of a similar tube controlled by a 1000-cycle voltage from a standard frequency generator. The apparatus has been applied in the present case to the measurement of the velocities of rifle bullets [see preceding Abstract]. AUTHOR.

See also Abstracts **2743, 2784, 2785.**

MECHANICS, QUANTUM.

2760. Numerical Solution of Schrödinger's Equation. G. E. Kimball and G. H. Shortley. *Phys. Rev.* 45. *pp.* 815–820, *June* 1, 1934.—Schrödinger's equation may be approximated to any desired accuracy by a difference equation over a lattice covering the region of integration. The solutions of this difference equation minimise a certain quadratic form (analogous to the energy integral $\int\psi a H\psi$) subject to certain normalisation and, for the higher states, orthogonality conditions. A practical numerical method is developed for the solution of this variation problem. By altering the values of a rough solution at each lattice point in turn by a simple improvement formula, the value of the quadratic form is continually decreased until the desired minimum is reached. Illustrations of the method are given for one-dimensional problems. Practical details are given for handling two-dimensional lattices, in particular for the solution of the problem of one electron in an axially symmetric field. AUTHORS.

2761. Approximate Wave Function for the Normal Helium Atom. D. R. Hartree and A. L. Ingman. *Manchester Phil. Soc., Mem.* 77. *pp.* 69–90, 1932–1933.—A function $\phi = e^{-k(r_1+r_2)/2}[1 - a e^{-k\beta r_{12}}]$ is proposed on physical and analytical grounds as likely to be a good simple approximation to the wave function of the neutral He atom in its normal state. The best values of the parameters k, a, β are determined by the variation method. The improvement over Hylleraas' simple wave function $\psi = e^{-k(r_1+r_2)/2}\, e^{k\beta r_{12}}$ is discussed in detail and found to be small. It is concluded that for work on other atoms, taking into account the dependence of the wave functions on the mutual distances between electrons, a linear expression for this dependence will afford an adequate approximation. N. M. B.

2762. Generalised Wave Mechanics. R. Zaïcoff. *Accad. Lincei, Atti*, 19. *pp.* 94–96, *Jan.* 21; 161–165, *Feb.* 4, *and pp.* 328–331, *March* 4, 1934.—A generalised form, applicable to Riemannian space, is given of the Dirac equations of the electron. The method is based on Hamiltonian differentiation of a suitable invariant. Comparison of this generalisation with those of Levi-Civita and J. M. Whittaker leads to the conclusion that these generalisations hold only when either a magnetic or an electric field is acting alone. For an arbitrary field, still another set of generalised Dirac equations is obtained which include the cases of the negative and the positive electron. The theory is mathematical and purely formal in character. G. C. McV.

2763. Waller's Value of the Quantum Defect for Non-Hydrogenic Atom. K. Basu. *Indian Phys. Math. J.* 5. *pp.* 1–4, *April*, 1934.—The quantum defect is deduced by the application of Schrödinger's perturbation theory. The perturbing potential is taken as $-\alpha\, e^2/2r^4$ (α = polarisability), which is the polarisation energy of the core for an alkali atom with the valency electron in the non-penetrating orbit. [See Abstract 365 (1927)]. N. M. B.

2764. Waves and Photons. Part III. A. Proca. *J. de Physique et le Radium*, 5. *pp.* 157–166, *April*, 1934.—Continuing previous work [see Abstract 2337 (1934)] the author develops his theory of the particles associated with light waves in its exact form employing the Dirac wave equation. The associated particles having positive energy correspond to right circularly polarised light, those having negative energy to left circularly polarised light. The associated particles differ from the " experimental photon " in the value of their spin which equals $h/4\pi$. They are identified with Pauli's neutrino. It is suggested that the photon is formed by the combination of a neutrino with an antineutrino (a " hole " or unoccupied state in the Dirac sense) of negative energy and equal but opposite spin. W. S. S.

2765. Equation of the Photon. K. Nikolsky. *Comptes Rendus,* 198. *pp.* 1901–1902, *May* 28, 1934.—A method of interpreting the wave associated with a photon in accordance with the hypothesis of de Broglie [see Abstract 481 (1933)] is briefly discussed. J. S. G. T.

2766. Wave-Statistical Theory of Electron Spin. K. C. Kar and K. K. Mukherjee. *Phil. Mag.* 17. *pp.* 993–1003, *May,* 1934.—It is shown how the spin-relativity formulæ for the eigenenergies of a spinning electron in a central field can be derived from the Schrödinger second-order wave equation without the use of Dirac's linear equations and non-commutative matrix coefficients. W. S. S.

2767. Application of Virial Theorem in the Theory of Thomas-Fermi. K. Ochiai and Y. Mizuno. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 167–177, *May,* 1934. *In English.*—A diatomic molecule in the theory of Thomas-Fermi is treated by the method of variation due to Lenz and Jensen [see Abstract 4774 and 4775 (1932)]. The kinetic and the potential energies separately cannot be determined as accurately as the total energy of the system, and the partition of the total energy into the kinetic and the potential parts is somewhat arbitrary, so far as the method of minimisation of the total energy is concerned. This ambiguity can be removed by the application of the virial theorem of Fock and Jensen. Numerical calculations are made for the nitrogen molecule. AUTHORS.

2768. Unified Treatment of Various Theories of Statistical Mechanics. F. v. Krbek. *Zeits. f. Physik,* 89. 1–2. *pp.* 83–86, 1934.—The possibility of unifying the various theories of statistical mechanics, based upon a suggestion of Brillouin, that the particles of a quantum gas, like those of the gas considered in classical theory, are indistinguishable one from another, is briefly discussed. J. S. G. T.

2769. Law of Combination and Resolution in Statistical Mechanics. G. Krutkow. *Comptes Rendus de l'Accad. des Sciences, U.R.S.S.* 1. 9. *pp.* 551–552, 1934. *In German.*—In continuation of previous work [see Abstract 2498 (1933)] the author discusses briefly the significance of statistical temperature (1) in a system composed of two separate systems having the same temperature, and (2) in two systems formed from one system. In the former case, the temperature, θ, is the same as that of the two initial systems ; in the second case a corresponding result is merely an expression of the law of probability. J. S. G. T.

See also Abstracts **2676, 2771, 2786, 2852, 2875, 2894, 2928, 2983, 2992, 3043, 3044.**

RELATIVITY AND ETHER.

2770. Displacement of Perihelion in the Theory of Relativity with Regard to the Oblateness of the Sun. P. Burgatti. *Accad. Lincei, Atti,* 19. *pp.* 199–205, *Feb.* 18, 1934.—The explanation of the displacement of the perihelion of Mercury is considered a crucial test of the relativity hypotheses, but in such explanations the oblateness of the sun is neglected. If we take this oblateness into account, the theory of relativity gives the displacement of perihelion to be $2\pi\{3a_0/a + 2165e(a_0/a)^2\} \times 10^{-8}$, where e measures the sun's oblateness, a_0 the mean radius of the earth's orbit, and a that of the planet considered. The first term already contributes 42" to the displacement and the smallest value of e brings a disagreement with observation. A. J. McC.

2771. Unitary Theory of Physical Space and the Relativistic Equations of Atomic Mechanics. A. de M. Fernandes. *Accad. Lincei, Atti,* 19. *pp.* 314–318, *March* 4, 1934.—Dirac's four wave-equations of the first order are strictly bound to a pseudo-cartesian coordinate system, which supposes the pseudo-euclidean space to be free from gravitational phenomena. In an attempt to generalise Dirac's results to apply to any coordinate system in a gravitational field, Levi-Civita was led to a set of tensor wave-equations. It is here shown that these wave-equations are compatible with the unitary conception of space in which is defined a metric and a linear connection. A. J. McC.

See also Abstracts 2801, 3044.

SOLUTION.

See Abstracts 2880, 2994, 2946, 3005.

SURFACE TENSION AND COHESION.

2772. Capillary Depression of Mercury in Wide Tubes. J. Stulla-Götz. *Phys. Zeits.* 35. *pp.* 404–407, *May* 15, 1934.—A glass tube 30 mm. long was held half-immersed with the axis vertical at the centre of a dish of mercury of diameter 20 cm. The dish was supported on an iron plate floating in a larger dish of mercury standing on a brick pedestal. The height of the mercury meniscus at the centre of the tube and the height of the plane surface were measured by means of a Michelson interferometer, and thus the capillary depression was found. The curve connecting the capillary depression of clean mercury at 8° C. and 90 % humidity with the tube diameter passes through 4 microns at 27 mm. dia., 1 micron at 31 mm. and zero at 50 mm. From observations on contaminated mercury it is concluded that in tubes of diameter 45 mm. and above the surface tension does not affect the depression of the meniscus. P. H. B.

2773. Purity Required for Surface-Tension Measurements. T. C. Sutton and H. L. Harden. *Phys. Soc., Proc.* 46. *p.* 510; *Disc.,* 511, *July* 1, 1934.—The extent to which impurities affect the measured value of the surface tension of a liquid depends on the method of measurement employed. This effect is applied to test whether the purity of a sample is adequate for the measurement of the surface tension of the pure liquid. AUTHORS.

See also Abstracts 2881, 2882, 2959.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

2774. Time-Balance. G. Keinath. *A.T.M.* 3. T52. *April,* 1934.—Gives details of the application of a pendulum as a standard for the time-balance [see Abstract 2361 (1934)] and comments on several records which are reproduced. [See following Abstract.] P. H. B.

2775. Time-Balance. R. Tamm. *V.D.I.* 78. *pp.* 556–558, *May* 5, 1934.—A further description of the apparatus already described by Keinath [see preceding Abstract.] P. H. B.

See also Abstracts 2758, 2759, 2819, 2859.

VACUA, HIGH.

2776. Self-Acting Mercury Air-Pump with Electromagnetic Pressure Regulator. P. Saffert and W. Wustrow. *Zeits. f. Elektrochem.* 40. *pp.* 231–232, *May,* 1934.—The pump, which is of the Toepler type, has its lower end connected to a reservoir with two vertical tubes. A rise in the air pressure of the vacuum system causes mercury to rise up one of the side tubes, thereby establishing contact between two platinum electrodes and thus passing current through a relay. The relay causes a tap to open, and admit air into the reservoir, this air forcing the mercury up the pump and thereby reducing the air pressure in the exhausted system. The overflow of the mercury establishes another electrical circuit, and shuts off the tap, at the same time reducing the air pressure in the reservoir to atmospheric pressure. G. E. B.

VISCOSITY, FRICTION AND LUBRICATION.

2777. Viscosity Formula for Binary Mixtures. T. Ishikawa. *Chem. Soc., Japan, Bull.* 9. *pp.* 155–161, *April,* 1934.—A solution viscosity formula is developed, which involves a constant m which is independent of temperature and concentration so long as the molecular compound exists in the concentration range. Binary mixtures of water-phenol, water-ethyl acetate, water-ethyl ether, were investigated from this point of view at temperatures ranging from 25° C. to 70° C. and at different concentrations. The results show that if the molecular compound exists without dissociation, the value of the constant m is 2; lower values indicate dissociation. F. J. B.

2778. Viscosity and Composition of Binary Mixtures. D. B. Macleod. *Faraday Soc., Trans.* 30. *pp.* 482–493, *June,* 1934.—The viscosity of mixtures is calculated making allowance for the change of volume on mixing and therefore of the change of free space. The ratio of the mean molecular weight after mixing to the mean of the molecular weights of the components is calculated and it is found that, where chemical action occurs, the mass action law is followed. A. S. C. L.

2779. Kinetic Theory of Viscosity. R. O. Herzog and H. Kudar. *Phys. Zeits.* 35. *pp.* 437–445, *June* 1, 1934.—Elaborating previous theoretical work [see Abstract 3384 (1933)] the authors' theory of the viscosity of liquids is extended to several special types of molecule. In a series of examples the conclusions are shown to apply satisfactorily to many typical organic liquids. The influence of molecular dipoles is discussed. J. P. A.

2780. Electrostatic Viscosity Effect. R. O. Herzog, H. Kudar and E. Paersch. *Phys. Zeits.* 35. *p.* 446, *June* 1, 1934.—An electrostatic field of about 2000 volts per cm. acts across the liquid in a special capillary viscometer. The time of efflux under constant pressure is found for several organic liquids, with and without the field. In some cases, notably those of chloroform, trimethyl bromide, diethyl ether, and ethyl iodide, the time is considerably greater when the field is acting. In other cases no effect is found. J. P. A.

See also Abstract 2729.

ASTRONOMY AND ASTROPHYSICS.

COMETS AND METEORS.

2781. Ellipsoid of Dispersion of Cometary Perihelia. P. Bourgeois and J. F. Cox. *Bull. Astronomique*, 8. 5. *pp.* 271–304, 1933.—The perihelion distances are treated as departures from a mean and a representation sought as for a distribution of vectors of varying length and direction around one centre ; this is analogous to stellar problems of residual velocity. An analysis of the procedure is given. The sphere is divided into 48 areas but the number of equations is halved by combining opposite pairs ; one reason is the lack of southern observations until recently. Very full tables are given of the data used and the resulting equations. Five classes are set up :—Parabolic orbits before and after 1750—the former mainly not very accurate ; hyperbolic orbits ; elliptic orbits except the final group ; and periodic comets observed at last return. The ellipsoid found for all comets has its smallest axis near the poles of the ecliptic and its longest not far from the direction of the centre of the galaxy. The study of the residuals by classes shows that while the early comets are naturally nearer to the sun on the average, their ellipsoid is sensibly homothetic to that of later ones. The ellipsoid for elliptic orbits is however turned about 90°. The question remains whether the relation found to the ecliptic is due to solar origin of comets or merely to observational conditions ; or whether the ellipsoid is a combination of the effects of observational limitations and the conditions under which comets enter the solar system. This problem is only stated in this paper. T. L. M.

2782. Ephemeris of the Radiant-Point of the Delta Aquarid Meteor Stream. R. A. McIntosh. *Roy. Astron. Soc., M.N.* 94. *pp.* 583–587, *April*, 1934.—The method used to calculate the mean radiant was to refer the radiant-point obtained from each night's observations to the latitude of the radiant and the difference in longitude between radiants and the apex of the earth's motion, as coordinates. The observations were made in New Zealand during the years 1926–1933. The mean position of the radiant was : Longitude of radiants minus longitude of meteoric apex, 301°·0 ; Latitude, − 8°·1. The elements of the orbit calculated are also given. G. C. McV.

COSMOGONY.

2783. Expansion of the Einstein Universe by Condensation. N. K. Chatterjee. *Calcutta Math. Soc., Bull.* 25. *pp.* 135–138, *Sept.*, 1933.—The result found by Sen [see Abstract 2822 (1933)] that the formation of a condensation of constant density in an Einstein universe would cause the latter to expand, is extended to the case when the density of the condensation varies with distance from its centre according to a certain law. Expansion of the Einstein universe is again found to occur when condensations of this type form in it. G. C. McV.

2784. Newtonian Universes and the Curvature of Space. E. A. Milne and W. H. McCrea. *Q. J. Mathematics* (*Oxford Series*), 5. *pp.* 73–80, *March*, 1934.—The authors consider a distribution of matter in Euclidean space obeying the Newtonian law of gravitation and moving so that the velocity of a particle of matter, at distance r from the observer at time t, is radial in direction and a function of r and t. It is also assumed that the density, ρ, of the distribution varies with the time only and that the usual equation of continuity holds. It can then be shown that $\rho = B/R^3(t)$ and $r = f\,R(t)$, where B and f are constants. Further, the equation for determining R(t) is exactly of the same form as the equation for determining the radius of an expanding universe, of radius R, in which the pressure and the cosmical constant are both zero, obtained by general relativity. In this analogy an expanding space of positive, zero or negative curvature corresponds to distributions of matter the particles of which all possess elliptic, parabolic or hyperbolic velocities of escape respectively. The cosmical constant can also be introduced into the theory by assuming that a repulsive force proportional to the distance is acting, as well as gravitation. The velocity-distance relation in these distributions is $v = r\,[\frac{8}{3}\,\pi\,G\,\rho + A\,\rho^{2/3}]^{1/2}$ where A, G are constants. [See following Abstract.] G. C. McV.

2785. Newtonian Expanding Universe. E. A. Milne. *Q. J. Mathematics* (*Oxford Series*), 5. *pp.* 64–72, *March*, 1934.—The particular case, in which the particles have the parabolic velocity, of the Newtonian systems dealt with by Milne and McCrea [see preceding Abstract], is considered in detail. It is shown to correspond to a relativistic universe of zero spatial curvature in which the cosmical constant is zero. The author lays stress on the fact that observations of the universe as yet extend over such a small part of it that Newtonian mechanics provides as good a description of phenomena as does general relativity. G. C. McV.

2786. Dimensions of Observed Universe. E. Reichenbächer. *Phys. Zeits.* 35. *pp.* 410–412, *May* 15, 1934.—The event is to be regarded as defined by a single wave-function involving only one independent variable and therefore truly one-dimensional. An observation is the interrelation of two such, giving two first-order equations. These can be replaced, with elimination of one wave-function, by a second-order equation under certain conditions [see Abstract 1455 (1934)] and this is only possible in a four-dimensional manifold. Hence the observed universe is necessarily four-dimensional. If the external wave-function is eliminated instead a similar second-order equation is obtained; self-observation is thus also four-dimensional, when in relation to an external world. When no such intervenes, only the one wave-function is observed, and is interpreted as Time. T. L. M.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

2787. Eccentricity of the Orbit in the Problem of Two Bodies of Variable Mass. D. Graffi. *Accad. Lincei, Atti,* 19. *pp.* 144–151, *Feb.* 4, *and pp.* 228–233, *Feb.* 18, 1934.—It is known [see Abstract 4871 (1932)] that in the problem of two bodies of variable mass the eccentricity of the orbit does not in general remain constant. It is interesting to verify that these changes of eccentricity remain negligible for considerable variations of mass and for long intervals of time. Starting from the concept of adiabatic invariants an upper limit for the variation of eccentricity is obtained and applied to cases of double stars. A. J. McC.

NEBULÆ.

2788. Photometric Measures of the Nebula N.G.C. 205. J. H. Reynolds. *Roy. Astron. Soc., M.N.* 94. *pp.* 519–521, *April,* 1934.—Negatives of this elliptical nebula taken at Helwan were measured by the recording photometer of the Cambridge Solar Physics Observatory and curves of light-intensity for the whole surface of the nebula were obtained. At the centre of the nebula the light-intensity rises to a very sharp peak and this can hardly be explained by a concentration of stars. G. C. McV.

2789. Forbidden Lines of NeV in Nebular Spectra. P. Swings and B. Edlén. *Comptes Rendus*, 198. *pp.* 1748–1750, *May* 14, 1934.—The authors confirm the general conclusions of Boyce, Menzel and Payne [see Abstract 3976 (1933)], but dispute the point that the line 4726 Å, seen in Novae Pictoris and Persei, is due to the forbidden (auroral) transition ${}^2D^0 - {}^2P^0$. For NeV, they find from the two nebular lines, ${}^3P_2 - {}^1D_2$, and ${}^3P_1 - {}^1D_2$, that ${}^3P_2 - {}^1D_2$: $\lambda = 3423{\cdot}2 \pm 5$ Å, and ${}^3P_1 - {}^1D_2$: $\lambda = 3343{\cdot}5 \pm 5$ Å. In certain nebulæ Wright has observed two lines λλ 3346 and 3426·2, and the intensities estimated by him are in accord with Condon's theoretical results for these lines. Both lines have been seen by H. H. Plaskett in Z Andromedæ; 3426 has also been seen by Wright in Nova Ophiuchi (1920); Bowen has confirmed Eddington's theoretical suggestion that 2426·2 and 3346 (as forbidden lines) are only found in nebulæ where excitation is most intense. The authors conclude that NeV emission lines correspond to the strongest ionisation hitherto observed in nebulæ and point to analogous ionisations in Wolf-Rayet stars. To obtain NeV emission, the minimum temperature must be of the order of 100,000°. [See following Abstract.] A. S. D. M.

2790. Forbidden Lines in Nebulæ and Novæ. B. Edlén and P. Swings. *Comptes Rendus*, 198. *pp.* 1842–1845, *May* 23, 1934.—The authors tabulate the known wave-numbers for forbidden transitions of the configurations $2s^2 2p^2$, $2s^2 2p^3$, $2s^2 2p^4$ and examine certain identifications by Boyce, Menzel and Payne [see Abstract 3976 (1933)]. Doubt is thrown particularly on certain fluorine identifications in N Pictoris. Ne V is identified with two nebular lines. [See preceding Abstract.] T. L. M.

2791. Velocity-Distance Relation for Isolated Extra-Galactic Nebulæ. E. Hubble and M. L. Humason. *Nat. Acad. Sci., Proc.* 20. *pp.* 264–268, *May*, 1934.—Velocities are available for 85 isolated nebulæ. A linear relation to magnitude is clearly shown; $\log v = 0{\cdot}2\, m + 0{\cdot}71$; the same relation as for clusters of nebulæ except that the constant in that case was 0·51. The displacement shown by the change of constant is a selection effect according to apparent magnitude. The dispersion is discussed. The selection effect had previously hindered the use of these objects in determining the relation. T. L. M.

See also Abstracts 2804, 2805.

PLANETS.

2792. Distribution of Perihelia and Nodes of Asteroids. K. Akiyama. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 207–210, *April*, 1934. *In English.*—The range of mean motions from 600″ to 1150″ is divided into three equal sections. For known asteroids in each section and for the three combined (1194 objects) frequency polygons with regard to longitudes of perihelion, proper perihelion, node, and proper node are reproduced. Frequency functions are determined. The distribution of discoveries throughout the year shows a single maximum in autumn, due to the location of observatories engaged in this work. Diagrams are given showing perihelion and node against date of discovery. The first shows the climatic effect on discovery combined with the tendency for discovery at perihelion.

The second shows two maxima corresponding to the tendency for discovery at one or other node. The principal features of the frequency functions are thus accounted for, and appear to have no further significance. A wider distribution of active observatories is called for. T. L. M.

See also Abstract 2770.

STARS.

2793. Distribution of Stellar Luminosities Derived from Trigonometric Parallaxes. J. J. Nassau and S. W. McCuskey. *Roy. Astron. Soc., M.N.* 94. *pp.* 564–583, *April,* 1934.—An analysis is made of the parallaxes of stars, some four thousand in number, which were available at the end of May, 1933. The various types of corrections necessary to reduce the observations to uniformity were applied and the absolute magnitudes of the stars were derived. The distribution of luminosities amongst the various spectral classes was found to be in good agreement with the results obtained by other investigators using different methods. G. C. McV.

2794. Space-Velocity of B-Type Stars. H. Mineur and P. Guintini. *Bull. Astronomique,* 8. 5. *pp.* 227–270, 1933.—A detailed account is given of the methods of calculation and the results of a study of the space-velocities of 1000 B stars. The galactic plane was divided into 49 regions and the velocity of the group of B stars lying perpendicularly above and below each region was calculated. These 49 velocities were then investigated by analytical and graphical methods in order to find to what extent they could be interpreted as a single velocity of rotation about some point. Systematic deviations from a pure rotation were found but on the whole there was no incompatibility with the Oort-Lindblad theory of the structure of the galaxy. It was also concluded that the centre of the galaxy lies at a distance of 11,500 parsecs from the sun, in longitude 330°. There was no systematic change in the velocities of the groups of B stars with distance from the galactic plane, and the residual velocities, after deduction of the rotational motion, could be represented by a very slightly flattened ellipsoid of revolution around the line of the galactic poles. G. C. McV.

2795. Radial Velocities of 477 Stars. W. E. Harper. *Dominion Astrophys. Obs., Publ.* 6. 10. *pp.* 151–202, 1934.—Since A stars are more numerous in the Milky Way than elsewhere, in process of measuring them for absolute magnitude the programme of the summer months is rounded off by observing F to M type (visual magnitudes 6 and 6·5) in R.A., 10^h–16^h, selected from the Harvard Revised, Vol. 50. The A stars have been measured line by line in the micrometer engine, showing that the Victoria observers are systematically negative to about 1 km./sec.; F, G, K, and M stars, in the Hartmann spectrocomparator, against Procyon, the Sky, Arcturus, and α Herculis respectively. Since the systematic differences may not be the same for the two forms of measurement, spectra of stars not in the original place have been measured, and a table is given of these. A. S. D. M.

2796. Spectrometric Studies of Wolf Rayet Stars and Novæ. C. S. Beals. *Dominion Astrophys. Obs. Victoria, Publ.* 6. 9. *pp.* 95–148, 1934.—Section I deals with instruments and calibration methods, section II with the author's theory for the broad band emission in Wolf-Rayet stars by the continuous ejection of atoms by radiation pressure from the star's surface, involving a flat-topped contour for the band, and evidence is found for this at certain periods in the history of Nova Aquilae, but only in the case of a single Wolf-Rayet star (H.D.193793 at λ5696) has this flat-topped contour been established beyond doubt. In Section III, the total intensities of bands are used to classify Wolf-Rayet stars, and to determine their temperatures. New evidence is given for the dual sequence according to C. and to N. Nova-spectra in their later stages tend to fall into the N sequence. Section IV is on the widely different temperature values and sequences given by the two theories of thermal ionisation and of colour indices. The author gets the temperatures of (1) several Wolf-Rayet stars, (2) Nova Aquilae and (3) P. Cygni by Zanstra's method, and obtained for (1) 50,000° to 100,000°, for (2) 65,000°, and for (3) 20,000°. He considers that O-star temperatures must approximate to those of Wolf-Rayet, but finds it difficult to explain the difference in their colour temperatures, and he discusses Gerasimovič's theory of departure from black-body laws. A. S. D. M.

2797. Hypothesis of Radial Ejection of High-Speed Atoms from Wolf-Rayet Stars and Novæ. S. Chandrasekhar. *Roy. Astron. Soc., M.N.* 94. *pp.* 522–538, *April,* 1934.—If the nature of Wolf-Rayet and Nova emission is due to the continual ejection of high-speed atoms from the parent star, it follows that this ejection can take place only according to one or other of two mutually exclusive mechanisms. Mechanism A consists in the presence at the boundary of the star of a repulsive force acting on the atoms, *e.g.*, the force due to unbalanced radiation pressure. Mechanism B assumes that at the boundary, an atom receives a large initial outward velocity and then is continually decelerated in the gravitational field of the star. The contours of the emission bands to be expected on each of these hypotheses are worked out. The contours on mechanism A show much less assymmetry than on mechanism B, and the observational material is formally more consistent with the ejection process taking place according to mechanism A. But there are difficulties in the way of accepting this latter mechanism, which prevent a definite conclusion from being attained. G. C. McV.

2798. Sodium and Magnesium in Stellar Spectra. A. D. Thackeray. *Roy. Astron. Soc., M.N.* 94. *pp.* 538–549, *April,* 1934.—Measures of total intensities of the D lines (Na) and the Mg lines 5183, 5172 and some subordinate lines are given from two separate series of plates taken with different instruments, for a number of stars of spectral type M to A. If these measures are interpreted by the square-root law, it is found that in all cases the change of temperature is not nearly as rapid as that given by theory for the number of atoms above a given optical depth. Doppler broadening accounts for most of the excess strength in the A0 stars. The weakness in the latest types may be due to a greatly increased opacity coefficient or to a higher temperature scale. The possibility of turbulence is also discussed. G. C. McV.

2799. Significance of Counts of Spectral Types F5 to G5. J. Schilt. *Astron. J. No.* 1008. *pp.* 121–128, *May* 19, 1934.—An investigation of star-ratios from (*a*) three Yale Zone Catalogues, (*b*) Southern Selected Areas, (*c*) four Cordoba Durchmusterung Zones, for the study of intermediate type stars, to obtain the distance at which star density in space is nearly uniform. Star counts in (*a*) have no larger errors in magnitude than may be due to the natural uncertainty of counted numbers; for (*b*) Becker has reobserved the central parts of areas 193 and 194, and confirms that the space density of stars in them is higher than in regions near the sun. Having plotted M against H ($H = m + 5 \log \mu$), for all stars brighter than 500, of types F5, F8, G0 and G5 separately, the author finds that (counting as *not* giants such stars as have their absolute magnitude near $+1 \cdot 8$) there is no ambiguity between giants and dwarfs for F5 stars; only one star is doubtful for F8, but is probably a dwarf on account of its H; one or two are doubtful for G0; for G5, however, there is only a slight indication of the existence of a band of minimum density. In the Henry Draper catalogue, counts have been made in certain right ascensions and a table is given of the counted numbers multiplied by the ratio (whole sky)/(area). The percentage of giants is very small, decreasing from 60 % for the brightest stars to 45 % at magnitude 5 and to zero at magnitude 8·5. A. S. D. M.

2800. Zero Point of Greenwich Colour Temperature System. W. M. H. Greaves, C. Davidson and E. Martin. *Roy. Astron. Soc., M.N.* 94. *pp.* 488–507, *April,* 1934.—The zero point is defined by the mean of nine stars of type Ao. The value found in 1931 by comparisons with a standard acetylene burner was 14,300°; this is now altered to 16,100° by a revision of the N.P.L. calibration standards. The work has therefore been repeated using an electric vacuum tungsten lamp. A standard star was photographed with the telescope, and on the same plate the lamp spectrum with the laboratory spectrograph. The acetylene burner was used to determine the differences in the transmission of the two optical systems. The spectra were measured at 20 points. The experimental details and reduction of the plates are very fully discussed. The atmospheric reddening is derived from observations of high and low stars and azimuth effect is tabulated. The resulting zero point value is 18,100°. The uncertainty remains relatively large. The Greenwich programme will therefore be restricted to relative observations for gradient, relative to the zero point, which can be determined with relative accuracy. An accurate zero determination will require the co-operation of several observatories in good climatic conditions. T. L. M.

2801. Equilibrium of an Incompressible Sphere. N. R. Sen. *Roy. Astron. Soc., M.N.* 94. *pp.* 550–564, *April,* 1934.—The solution of the problem, in general relativity, of the incompressible sphere whose proper-density is constant is arrived at by numerical calculation. It is shown that, for a given density, there exists a sphere of maximum radius as well as a sphere of maximum gravitational mass, these two spheres not being identical. For given radius (less than the maximum) and given density, there are two spheres of different masses and central pressures of which one has a smaller, and the other a greater, central pressure than that of the sphere of maximum radius. These results are in contrast to the classical case. A sphere of density 3×10^{12} gm./c.c. (the assumed maximum density of matter) would have a maximum radius of only 133 km. and a mass nearly twenty-four times that of the sun. The bearing of these results on Milne's theory of the cores of stars is mentioned. G. C. McV.

2802. New Members of Hyades Cluster. P. J. van Rhijn and J. J. Raimond, Jr. *Roy. Astron. Soc., M.N.* 94. *pp.* 508–518, *April,* 1934.—The proper motions of stars in six parts of the Hyades field are found from plates taken specially at Bordeaux, repeating international chart plates. The time interval is from 13 to 23 years. The magnitudes of the stars are derived from special plates taken at Johannesburg (Franklin-Adams telescope), and are compared with those found by Hertzsprung.

Data are tabulated for 32 cluster stars, 13 being new, as well as for nine doubtful stars. It is shown that the results are nearly complete down to magnitude 14. Absolutely faint stars are less frequent in the cluster than in the neighbourhood of the sun, as compared with absolutely bright stars ; this holds for some other clusters. T. L. M.

2803. Visual Observations of δ Cephei. D. B. McLaughlin. *Astron. J. No.* 1007. *pp.* 113–119, *April* 28, 1934.—500 estimates are discussed, with normal places and light-curves ; the period covered is 1927–1932. The magnitudes of the comparison stars are investigated. The average residual of a normal place from the smooth curve is only $0^{m}\cdot02$. The earlier observations give a light curve differing materially from the later, the principal changes being an increase of $0^{m}\cdot05$ at maximum and a lowering of the whole section round minimum by $0^{m}_{\cdot}\cdot07$. The author reserves decision as to whether this is due to real change, change of personal equation, or change of observational technique. The rise is throughout steeper than usually found. The work is primarily intended as a control on observations of irregular variables. T. L. M.

2804. Super-Novae. W. Baade and F. Zwicky. *Nat. Acad. Sci., Proc.* 20. *pp.* 254-259, *May*, 1934.—Common novae, with maximum magnitude around $-5\cdot8$, are distinguished from much less frequent super-novae, with maximum of the order -13. These are at maximum nearly as bright as the whole nebula in which they originate ; they appear over the whole accessible range of spiral nebulae ; their radiation in a few days is of the order of 10^7 years of solar radiation at the present rate. N And 1885 and Tycho's star are examples. The mechanism is considered from two points of view : (1) Assuming the radius similar to that of common novae, and observed visual magnitude to be the integrated red end of a black body radiation, the effective temperature is found to be of the order of 10^6 degrees ; (2) Assuming very great expansion and effective temperature similar to the sun's, the kinetic energy of individual particles would be comparable with the energy of annihilation. Both views suggest the transition of an ordinary star to a body of considerably smaller mass. [See following Abstract.] T. L. M.

2805. Cosmic Rays from Super-Novae. W. Baade and F. Zwicky. *Nat. Acad. Sci., Proc.* 20. *pp.* 259–263, *May*, 1934.—The authors collect the evidence suggesting an origin for cosmic rays outside the galactic system ; together with the difficulties of current hypotheses. The radiation of a super-nova [see preceding Abstract] corresponds to 10^8 volts per proton. Reasonable assumptions as to the frequency of super-novae enable the authors to derive a good agreement with the observed intensity of cosmic rays. A super-nova in one of the nearer spirals would produce an appreciable increase in cosmic ray intensity for a few days ; such a phenomenon in the galactic system would produce a very great temporary increase. The authors advance the possibility that a super-nova may become a neutron star, closely packed and very stable. T. L. M.

See also Abstracts 2787, 2790, 2875.

SUN.

See Abstract 2770.

GEOPHYSICS.

HYDROSPHERE, PHYSICS OF THE.

2806. Papers on the Tunami (Sea-Waves) of 1933 on the Sanriku Coast, Japan. *Tokyo Univ. Earthquake Research Inst., Bull., March,* 1934.—A series of papers as follows: "Past Tunami of the Sanriku District" (in Japanese) by **A. Imamura** (pp. 1–17); "Tunami Considered as a Phenomenon of Sea Water Overflowing the Land" (in English), by **M. Ishimoto** and **T. Hagiwara** (pp. 17–24); "Luminous Phenomena Accompanying Destructive Sea-Waves (Tunami)" (in English), by **T. Terada** (pp. 25–35); "Abnormally High Waves on the Coast of Sanriku in Japan, on March 3, 1933," (in English), by **S. Yamaguti** (pp. 36–54); "Estimation of Energy of Tunami and Protection of Coasts" (in English), by **H. Matuo** (pp. 55–64); "Prevention of Damage of Tunami" (in English), by **H. Matuo** (pp. 65–76); "Sound Phenomena of the Sanriku Earthquake on March 3, 1933" (in Japanese), by **W. Inouye** (pp. 77–86); "Luminous Phenomena that Accompanied the Great Sanriku Tunami in 1933 (Part I)" (in English), by **K. Musya** (pp. 87–111); "Investigation of the Sanriku Tunami Based on Mareogram Data" (in English), by **N. Miyabe** (pp. 112–126); "Tunami Damage, March 3, 1933, and the Topography of Sanriku Coast, Japan" (in Japanese), by **Y. Ôtuka** (pp. 127–151); "Mechanism of Seismic Sea Wave Generation," Part I (in English), by **R. Takahasi** (pp. 152–181); "Long Wave in a Bay of Variable Section" (1), (in English), by **G. Nishimura** and **K. Kanai** (pp. 182–197); "Seiches and Surface Waves in Ohunato Bay and Two Other Bays" (in English), by **R. Takahasi** (pp. 198–217); "Heights of Tunami and Damage to Structures" (in English), by **N. Nasu** (pp. 218–227); "Unusual Behaviour of Fishes Prior to Earthquake" (in English), by **Y. Suyehiro** (pp. 228–231); "Propagation of Tunami Waves," Part I (in English), by **G. Nishimura** and **T. Takayama** (pp. 232–271). The Bulletin is fully illustrated.

See also Abstract 2807.

LAND, PHYSICS OF THE

2807. Load Tilt and Body Tilt at Bidston. A. T. Doodson and R. H. Corkan. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 203–212, *May,* 1934.—Experiments to determine the tilt of the earth's surface are described. The semi-diurnal constituents of the tilt are in fair agreement with those of the tides, but the diurnal are greater and of opposite phase. The tilt is of two kinds, (*a*) a load tilt due to local loading, and (*b*) a "body-tilt" due to the yielding of a partially rigid earth to gravitational forces. The semi-diurnal constituents of the body tilt are interrelated according to the equilibrium law. The diurnal are anomalous. The body tilt as a whole does not follow the equilibrium law, and the diurnal body tilt appears to lag behind the diurnal equilibrium tide by nearly 4 hours. W. A. R.

METEOROLOGY.

2808. Ozone Distribution in the Atmosphere and the Reversal Effect. J. Gauzit. *Comptes Rendus*, 198. *pp*. 1800–1802, *May* 14, 1934. Götz found from examination of the spectrum of light diffused from the sky a phenomenon called the "reversal effect." For two wave-lengths λ and λ^1, one strongly and the other feebly absorbed by ozone, giving intensities for diffused light at the zenith of I and I^1, it is found that $\log I/I^1$ varies with solar altitude and is a minimum when the sun is at about 5° elevation. This is attributed to diffusion of light at high levels either inside and above the ozone levels or solely at a level above the ozone. Calculations support the idea of a reversal effect. Perkeris considers the calculations are erroneous or wrongly interpreted since neither primary nor secondary diffusion can explain the reversal effect. The author brings forward arguments to controvert the views of Perkeris. R. S. R.

2809. Spectral Intensity Distribution in the Light of the Night Sky and of the Aurora. L. Vegard and E. Tönsberg. *Zeits. f. Physik*, 88. 11–12. *pp*. 709–726, *May* 5, 1934.—Measurements of spectral intensity were made in Tromsö using the apparatus previously described [see Abstract 970 (1933)] particularly for long waves for the aurora, and for the night sky when the aurora was absent. Some bands in the red are two to three times stronger for the night sky than for the aurora in comparison with the green auroral line, and some negative nitrogen bands are weaker, while the band at 5950 Å which occurs in the aurora is not found in the night sky spectrum. The light from the night sky with its large deviations from the aurora agrees well with Vegard's views in earlier papers. The relative intensity measurements in the long-wave part of the auroral spectrum include also the infra-red bands and the so-called second green line. The results of this and earlier measurements are tabulated.

R. S. R.

2810. Green Flash at Sunset. (Lord) Rayleigh. *Phys. Soc., Proc.* 46. *pp*. 487–493; *Disc., pp*. 493–498, *July* 1, 1934.—An experimental imitation of the phenomenon of the green flash at sunset is described, an artificial source of light and a prism whose dispersion is equal to the atmospheric dispersion being used. A straight edge parallel to the base of the prism plays the part of the horizon. The observer was 74 m. from the prism. On moving the eye into the shadow of the straight edge, the bluish-green flash was well seen. Other experiments deal more specifically with the colour of the flash. By means of substantially the same arrangement with large dispersion and short distances the simultaneous-contrast effect of a red or orange background was studied, but it was not found possible to obtain a green as opposed to a blue flash in this way. If, however, a liquid containing small particles in suitable concentration is used in front of the source it is easy to make the disappearing flash of a brilliant green colour. The source viewed by transmission is then a pale orange. It is concluded that when the flash is bright green, atmospheric filtration is acting to remove the blue light. Contrast effects due to the red or orange colour of the sky do not seem to be important in this connection. AUTHOR.

2811. Definite Rain Measurements. H. Koschmieder. *Monthly Weather Rev.* 62. *pp*. 5–7, *Jan.*, 1934.—A type of rain gauge designed to overcome the errors in rain measurements, due to disturbance of air currents by the usual type of instrument and known as the "Jevons effect," is described and illustrated by diagrams and photographs. The instrument is sunk into the ground, the aperture level with the surface. Possible errors due to splashing are avoided by surrounding the mouth with a brush, bristles upwards. Two types are used, diameter of larger brush 150 cm. Results of comparison with the usual standard gauge, given in tabular form, show that the rainfall recorded by the new type, though approximately the same in calm and light winds, is considerably greater during high winds when the Jevons effect is operative than that indicated by the old type. With the sunken gauge taken as normal, the Jevons effect for the normal upright gauge can be determined as a function of the wind velocity. A table gives the factors necessary to convert upright gauge values to true values. A honeycomb type of surround in place of the brush is also described and illustrated. A. E. M. G.

2812. Visibility Meter for Selective Fog Penetration. L. Foitzik. *Naturwiss.* 22. *pp.* 384–386, *June* 1, 1934.—An arrangement is described for the measurement of the coefficient of diminution of visibility due to mist or fog and results are shown for different distances of penetration for red, green and blue light. It appears that for white mists formed by large drops of water the coefficient is approximately the same for all wavelengths for distances up to 1 km., but for greater distances, dirty fogs of small droplets, such as occur in towns, show a greater diminution for blue light than for red. H. M. B.

2813. Thermohygrometer. L. Scriba. *Zeits. f. Instrumentenk.* 54. *pp.* 198–201, *June*, 1934.—An apparatus is described which simultaneously on a clock-like face shows: (1) the temperature in °C., (2) the maximum water content in gm./m^3., (3) the percentage relative humidity. The capillary tube of a spirit thermometer acts as the pointer of a hair hygrometer and by radial and transverse scales the above particulars are ascertained. For normal atmospheric conditions an accuracy of ± 1·5 % is obtained. H. M. B.

See also Abstracts 2748, 2845, 2846, 2861, 2866, 2952, 3067.

SEISMOLOGY.

2814. Seismic Waves. R. Einaudi. *Accad. Lincei, Atti,* 19. *pp.* 33–37, *Jan.* 7, 1934.—The principal phase of seismic waves comprises a first principal phase composed of horizontal-transversal vibrations (Love waves), and a second principal phase, composed of horizontal-longitudinal and vertical vibrations (Rayleigh waves). The most general types of waves that start directly from the hypocentre and are compatible with the conditions of zero force at the earth's surface are here investigated, and are found to be waves with horizontal-transversal vibrations, like the waves of the first principal phase. A. J. McC.

2815. Total Reflection in Acoustics and Optics Based on Experimental Results of Seismology. O. v. Schmidt and J. Picht. *Ann. d. Physik,* 19. 8. *pp.* 891–920, *May,* 1934.—In Part I Schmidt recapitulates former results in seismology and it is shown that the energy of a wave undergoing total reflection at the boundary of a second medium can be explained by consideration of the summation of the waves in the limiting ray. This summation wave becomes a plane wave after reflection and the total process is called "wandering reflection." In Part II the results are used in optics to remove the difficulty of disagreement with Fresnel's formula. In Part III the results are used to explain multiple wireless signals around the earth. Picht criticises some of Schmidt's views on energy summation in the limiting wave and considers the results obtained are of qualitative value only, mainly on account of the differences in optics and seismology for the type of wave dealt with and its absorption in the medium. R. S. R.

2816. Transmission of Rayleigh Waves in a Heterogeneous Medium. R. Stoneley. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 222–232, *May,* 1934.—For the discussion of surface waves in a continent a single-layer model is inadequate and even a two-layer model does not bring out the behaviour of shorter waves. Although the distribution of elastic properties is most probably discontinuous it is attempted to represent them by a continuous distribution, and, for Rayleigh waves in this paper a solid of constant density with its rigidity depending linearly on depth is employed and the equations of motion are established. The author discusses the applicability of the formulæ obtained to microseisms and the propagation of Rayleigh waves with heterogeneous material below is considered. R. S. R.

2817. Effect of Geological Structure upon Microseismic Disturbance. A. W. Lee. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 238–252, *May,* 1934.—In continuation of the investigation [see Abstract 3626 (1932)] of Rayleigh waves in a medium covered with a superficial layer numerical results are given for layers of any thickness. The computations include two cases (granite on tachylyte, and clay on granite), representing small and large differences between the properties of the materials in the layer and below. The velocity of propagation and the ratio of horizontal to vertical components depend upon the ratio of wave-length to the thickness of the layer; the results are in accordance with those given by Sezawa and Suzuki for superficial layers of the same density as the subjacent materials. The amplitudes with superficial layers are compared with those of simple Rayleigh waves having the same total energy per wave-length. The effect of a thin layer upon the horizontal motion is much greater than that upon the vertical motion; if the wave-length is less than about eight times the thickness of the layer the effect upon the vertical component becomes large, and the amplitudes of both components are very variable with changes in the thickness. The variations from place to place in the microseismic amplitudes are largely due to differences in the superficial strata, and the theory explains why the amplitudes at some observations depend upon the period. The de Bilt tabulations of the three components of microseismic disturbance from 1923 to 1929 are summarised. AUTHOR.

2818. Sympathetic Occurrence of Great Earthquakes in Widely Separated Regions. F. J. W. Whipple. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 233–238, *May,* 1934.—A paper on "Time and Space Distribution of Earthquakes" has recently been published by S. Yamaguti [see Abstract 2905 (1933)] in which it is maintained that great earthquakes in certain parts of the world induce such earthquakes in certain other regions. This conlusion is based on the statistics of 420 earthquakes which occurred in the years 1900 to 1931. Yamaguti supports his thesis by computing the 64 preferential ratios characterising the possible sequences of earthquakes in 8 zones. In the present paper it is shown that the magnitudes of the preferential ratios are such as would be produced by chance, the zones of successive earthquakes being equally likely to occur in any order. Thus there is no evidence of any systematic tendency in the sequence of great earthquakes. AUTHOR.

2819. Errors Due to Variation of Drum Rate. H. Jeffreys. *Roy. Astron. Soc., M.N., Geophys. Supplement,* 3. *pp.* 213–222, *May,* 1934. —The rate of a seismograph drum is in general checked each minute by marks due to an independent mechanism. If the clock rate is uniform linear interpolation is valid, but if it is irregular errors will arise due to variation of the intervals. Mathematical relations were obtained to determine the standard deviation under stated assumptions and these were applied for a number of seismograms from five observatories with different types of instruments. It was found that for all but the Milne-Shaw instrument the standard deviation was not more than 0·1 or 0·2 sec. and rarely 0·5 sec., while for the Milne-Shaw most readings are within 1 sec., but occasionally an error of 2 sec. occurs. R. S. R.

See also Abstracts 2738, 2806.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

2820. Observations of Atmospheric Electricity at Kew Observatory. F. J. Scrase. *Meteorolog. Office, Geophys. Mem.* 7. 60. [27 *pp.*], 1934.—A survey of results obtained from 1843 to 1931.

2821. Atmospheric Ionisation near the Ground during Thunderstorms. G. R. Wait and A. G. McNish. *Monthly Weather Rev.* 62. *pp.* 1–4, *Jan.,* 1934.—The apparatus used is described and represented diagrammatically. A reproduction of a record for a 24-hr. interval taken during a thunderstorm is given. A large increase in the rate of ion formation occurs during, and for several hours after thunderstorms and is found to be roughly proportional to the amount of rain. The relationship is illustrated diagrammatically. The same effect is not found to occur in hurricanes. A curve of the form $I = I_0e^{-\lambda t}$ with $\lambda = 1\cdot088$ per hr. represents the decay in the rate of ion formation after rain ceases. A similar curve for Ra B fits the data also fairly well. The author considers, therefore, that the decay products of Ra are mainly responsible for the increased ionisation. These products are present in thunderstorms as the air involved has only recently left the ground, but not in hurricanes as the rain-laden air in this case has come from the sea. The increase in ionic content during thunderstorms may, in the author's opinion, lend support to Wilson's theory of replenishment of the earth's charge.
A. E. M. G.

2822. Electric Field of the Thunder Cloud. J. Fischer. *Phys. Zeits.* 35. *pp.* 398–403, *May* 15, 1934.—The Ollendorf model of a charged cloud is shown to lead to an improbable regular charge distribution over the disc and no radial component in the plane of the disc. Also in the cloud the two charges are much farther apart than the lower one is from the earth. The author considers a simple charged disc with the natural charge distribution and obtains the field by simple functions. Applying this idea to the cloud, and extending it to two superposed layers, the basic phenomena are found to be as good and more easily explainable than with Ollendorf's model. The mathematical methods are easy and yield simple relations for the seat and magnitude of the maximum field at the earth's surface in relation to the height and radius of the cloud. R. S. R.

RADIOACTIVITY.

2823. Nuclear Changes in Radioactive Atoms. H. J. Walke. *Phil. Mag.* 17. *pp.* 1176–1189, *June*, 1934. Landé's views, combined with those of Kurie and Auger [see Abstracts 2925, 4858 and 4859 (1933)] are extended to the radio-elements. Materialisation of energy released by changes in the α-particle state within the nucleus give rise to a positron and an electron; the latter is expelled as a β-ray, the positron combines with a neutron to form a proton with emission of energy $= 2\cdot4 \times 10^6$e.v. (the highest γ-ray quantum emitted by a radioactive element is $2\cdot65 \times 10^6$ e.v.). The addition of this proton renders the nucleus (*i.e.*, a nucleus resulting from a β-ray expulsion) less stable. This is true of all cases except as regards the greater (compared with C′) stability of the C″ bodies, explained on the assumption that 41 α-particles form a closed (and so less unstable) system of shells, and UY, the instability of which is due to its odd neutron configuration. Emission of a second β-ray implies the formation of a second proton, which united with the first proton and two neutrons forms an α-particle with emission of so much energy as to result in a highly unstable nucleus (C′ body), whence expulsion of the α-particle results in the more stable D body with an even number of neutrons. The scheme is worked out in detail for all the radio-elements. C. A. S.

2824. Induced Radioactivity. G. C. Wick. *Accad. Lincei, Atti*, 19. *pp.* 319–324, *March* 4, 1934.—Fermi's neutrino theory of the natural β-ray spectrum is extended to the phenomena of induced radioactivity. The fundamental hypothesis consists in the introduction into the Hamiltonian of the system of a term which corresponds to the transition of a neutron into a proton during which an electron and a neutrino are expelled. The form of the term is deduced from considerations of relativistic invariance. The theory also allows of the reverse process, the transformation of a proton into a neutron with the destruction of an electron and a neutrino. If the electron which is absorbed is one of negative energy, this is equivalent to the emission of a positive electron. The last process is identified with the Curie-Joliot induced radioactivity [see Abstract 1069 (1934)] and the probability of the transitions are evaluated. Difficulties are experienced in deciding which are the forbidden transitions. Since the positive charge on the nucleus assists the expulsion of the positive electron the formula differs somewhat from that for ordinary β-particle emission. F. C. C.

2825. Induced Radioactivity. Irène Curie and F. Joliot. *J. de Physique et le Radium*, 5. *pp.* 153–156, *April*, 1934.—In an earlier paper [see Abstract 1546 (1934)] the authors have reported the production of an induced radioactivity by bombarding Al, Mg and B with α-particles. The present paper amplifies the statements made in the former paper and mentions some new results. The energy distribution of the positrons emitted from radiophosphorus and radionitrogen is given. It is noted that the positrons emitted from magnesium after bombardment consist of two groups and these are explained as arising from the two magnesium isotopes $^{24}_{12}$Mg and $^{25}_{12}$Mg. J. E. R. C.

2826. Induced Radioactivity of Sodium and Phosphorus. O. R. Frisch. *Nature*, 133. *pp.* 721–722, *May* 12, 1934.—By attaching the substance under investigation to a rotating arm it is possible to transfer it rapidly from the α-particle source used for bombardment to a Geiger-Müller counter. In this way it has been discovered that radioactivity can be induced in Na and P, the radiation consisting mainly of positrons and the half-value periods being 7 ± 1 sec. and 40 ± 5 min. respectively. The energy of the positrons emitted was examined and it appears to be about $1 \cdot 8 \times 10^6$ e.v. for Na, Al, and P. Chemical tests were used to identify as an isotope of Cl the radioactive element produced by bombardment of P. J. E. R. C.

2827. Samarium Radiation. M. Mäder. *Zeits. f. Physik,* 88. 9–10. *pp.* 601–611, *May* 2, 1934.—The ionisation of the radiation emitted by Sm is measured quantitatively by means of a Hoffmann electrometer. The dependence of the ionisation on pressure serves to determine the range. The quantity of 50,000 elementary ionic charges is associated with a range of α-radiation of Sm amounting to 1·16 cm. in air. A second type of radiation has also been discovered which is shown to be proton radiation of range 1·37 cm in air, the number of ions being 23,000. H. L. B.

2828. Analysis of the Fine Structure of the α-Particle Groups from Thorium C and of the Long Range Groups from Thorium C′. W. B. Lewis and B. V. Bowden. *Roy. Soc., Proc.* 145. *pp.* 235–249, *June* 2, 1934.—The fine structure of the α-particle groups from Th C has been examined by counting methods and magnetic focussing as previously described [see Abstract 2322 (1933)]. In agreement with Rosenblum and Valadares [see Abstract 2895 (1932)], five groups are found and their energies and relative intensities are determined. The energy difference between the two main groups has been measured directly in electron volts by alternatively accelerating and retarding the α-particles by an accurately known applied potential of about 10,000 volts. In this way the two groups were alternatively made to have the same velocity, and were examined without alteration of the magnetic field or movement of the source or counter. The two long range groups from thorium C′ have also been re-examined with great accuracy. All the results agree with independent β-ray measurements of corresponding α-ray energies as required by Gamow's theory of the fine structure of α-rays. Details of the level system of the thorium C-C″ nucleus cannot yet be worked out owing to possible changes in the theory of the internal conversion of γ-rays but the results are in fair agreement with the conclusions of Ellis and Mott. A table is appended summarising the accurate data of α-rays emitted by radioactive substances. F. C. C.

2829. Magnetic Spectrum of β-Rays Emitted by ThB + C + C′ + C″. R. Arnoult. *Comptes Rendus,* 198. *pp.* 1603–1605, *April* 30, 1934.—With the F line of ThB (HR 1381·5, energy $1 \cdot 4688 \times 10^5$) as standard [see Abstract 1963 (1934)] the energies and intensities of 23 lines in the magnetic spectrum of β-rays, and the energies and wave-lengths of $K\alpha_1$ and $K\alpha_2$ of atom No. 83 and of 5γ-rays emitted in the transformation ThB→ThC have been determined, with results pointing to the probability that the lines with HR = 821·9 – 1018·8 are due to electronic rearrangement of atoms of No. 83. The energies and intensities of 24 lines of the β-ray spectrum of ThC + C′ + C″ have also been determined. In most cases the origin is stated. C. A. S.

2830. Theory of β-Rays. G. Beck and K. Sitte. *Zeits. f. Physik,* 89. 3–4. *pp.* 259–260, *May* 24, 1934.—Some remarks and criticisms on the theory put forth by E. Fermi [see Abstract 1547 (1934)] and references to the points wherein it differs from the theory given by the authors. Reply by **E. Fermi,** *ibid.* 89. 7–8. *p.* 522, *June* 16, 1934. J. J. S.

2831. γ-Ray Ionisation in Gases as a Function of Pressure and Collecting Field. E. F. Cox. *Phys. Rev.* 45. *pp.* 503–506, *April* 15, 1934.—Ionisation by low intensity γ-radiation in N_2, CO_2, A and He has been measured with pressures of from 0·98 to 93 atmospheres of N_2, 61 atmospheres of CO_2, 25 atmospheres of A, and 98 atmospheres of He and with uniform collecting fields from 1·57 to 1065 volts/cm., direct comparison being made with the results of Bowen for air. The marked increase in current with increased collecting gradient and independence of the shape of the current-field curves on intensity of radiation up to the intensity used demands rejection of the wall emission theory of Broxon and adaptation of some recombination theory. Junction of Kaye and Laby's results to those of Bowen show that a gradient of 4×10^3 volts/cm. is saturation value for air at 10 atmospheres pressure. A field of only 100 volts/cm. is saturation value for argon up to 25 atmospheres, and with this field the current from the inert gases examined is a linear function of the pressure up to 25 atmospheres. AUTHOR.

2832. Secondary Radiation of Hard γ-Rays. W. Bothe and W. Horn. *Zeits. f. Physik,* 88. 9–10. *pp.* 683–698, *May* 2, 1934.—Using hard Th C″ γ-rays and a Geiger-Müller counter, the authors have investigated the dependence of the intensity of the secondary radiation on the material of the radiator, the scattering angles being 90° and 114°. The absorption of the secondary radiation in Pb was also investigated. The results show the existence of anomalous secondary radiation, the relative intensity of which, per electron, increases with the atomic number of the radiator, and is greater at 90° than at 114°. No marked effect attributable to nuclear α-particles was observed. Part of the radiation is at least as hard as the primary and part corresponds to an energy of $0{\cdot}5 \times 10^6$ e.V. Various explanations of the origin of the anomalous radiation are discussed. W. E. P.

2833. Electric Wind Method for the Measurement of the Radioactivity of the Air. G. Aliverti and T. Vacchieri. *Accad. Sci. Torino, Atti,* 69. 1. *Disp.* 2. *pp.* 252–256, 1934.—Continuing previous work [see Abstract 889 (1932)] it is shewn that (1) either a.c. or d.c. in either direction may be used, (2) d.c. with the points negatively charged is more efficient and allows the length of the collecting electrodes and the size of the ionisation chamber to be reduced, (3) a correction must be applied (depending on the magnitude of the current) for the amount of material deposited on the walls, if the determination of absolute values is required. F. C. C.

2834. Recoil Rays of Radioactive Atoms. F. Joliot. *J. de Physique et le Radium,* 5. *pp.* 219–224, *May,* 1934.—A new form of Wilson cloud chamber, operating at reduced pressure, was used to study the individual disintegrations of radioactive atoms and the paths of the recoil rays. The paths of the recoil rays of An and Ac A were found to undergo large deviations due mainly to the fluctuations in the number of collisions with the atoms of the gas. Collisions are much more probable at the place of disintegration than elsewhere and reasons for this are suggested. Abnormal collisions occur and these are attributed to the activation of the recoil atom which gives up its activation energy in the form of kinetic energy when it collides with another atom. W. E. P.

See also Abstracts **2989, 2993, 3020.**

RADIATION.

ABSORPTION AND TRANSMISSION.

2835. Infra-Red Absorption of Water from 2·5μ to 6·5μ. E. K. Plyler and C. J. Craven. *J. Chem. Phys.* 2. *pp.* 303–305, *June*, 1934.—A study has been made of the infra-red absorption bands of water from 2·5μ to 6·5μ and new bands have been found at 3·30μ, 5·56μ and 5·83μ. The band at 4·7μ showed an irregular envelope and may contain several components. The 3μ band showed a shift with thickness and is probably made up of four components. The change in position of the maximum in the 3μ region with thickness is explained as due to difference in sharpness of the components which constitute the band. The band at 6·15μ did not show the corresponding shift with thickness. AUTHORS.

2836. Infra-Red Absorption of Acid Solutions. E. K. Plyler and E. S. Barr. *J. Chem. Phys.* 2. *pp.* 306–310, *June*, 1934.—A study has been made of the absorption of aqueous solutions of HCl, HF, HBr, H_2SO_4, HNO_3, NaCl and NaBr in the region from 1·7μ to 6·5μ. Also HCOOH, C_6H_5COOH have been studied from 5μ to 6·5μ. No absorption bands were found for HCl and HBr in the regions of 3·5μ and 3·8μ, respectively, where there are strong bands in the gaseous state. All of the acid solutions showed a strong band at about 5·5μ. The position of this band varied slightly with the solute and the sharpness of the band was different for each acid. Another band was found at 2·40μ for the solutes. The 5·5μ band is explained as due to the undissociated molecule attached to a water molecule and the 2·40μ band as due to the same effect or to a hydrogen ion attached to a water molecule. AUTHORS.

See also Abstracts 2808, 2881, 2882, 2984.

COLORIMETRY.

2837. Colorimetry with a Spectrometer. R. A. Houstoun. *Phil. Mag.* 17. *pp.* 1047–1057, *May*, 1934.—Describes a simply constructed colorimeter, based on the vector principle, whereby the unknown colour is matched in turn with two mixtures each comprising a standard reference colour plus a spectrum colour. The proportions of reference colour and spectrum colour are varied by a polarisation method, the match being obtained by varying both the mixture proportions (which need not be known) and the wave-length of the spectrum colour. The method provides a means for determining the trichromatic coordinates of colours with apparatus available in any good laboratory. The reference colours are obtained from filters and, although the positions of these in the colour diagram can be obtained from the apparatus itself, the desirability of having suitable filters, with their colour coordinates certificated, made available for purchase, is urged by the author. W. S. S.

2838. Detection of Small Colour Differences in Dyed Textiles. R. D. Nutting. *J.O.S.A.* 24. *pp.* 135–138, *May*, 1934.—A description of the Hardy spectrophotometric method for measurement of colour. The curves are interpreted in terms of standard observer and coordinate system for colorimetry outlined by Judd and examples are taken of wool dyed with varying proportions of crocein scarlet conc and tartrazine O.

It is seen that small additions of the red dye to a solution of the yellow dye lower the transmission in accordance with Beer's Law. The applicability of the spectrophotometric method due to Hardy for the detection of small colour differences is established and a further paper by Hardy will give fuller details. The present work merely outlines the method and apparatus used. S. G. B.

See also Abstract 2878.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

2839. Magnetic Double Refraction of Solutions of Paramagnetic Salts. C. Münster. *Zeits. f. Physik*, 88. 9–10. *pp.* 593–600, *May* 2, 1934.—The magnetic double refraction of aqueous solutions of cerium nitrate was measured at different concentrations and temperatures. For a given solution the value of the Cotton-Mouton constant diminishes with rise of temperature, and for a given temperature and wave-length it increases with the concentration. The double refraction is caused by undissociated molecules of cerium nitrate. G. E. A.

2840. Magnetic Double Refraction of Gaseous Oxygen and Nitrogen and of Aqueous Solutions of Chlorates. A. Cotton and T. Belling. *Comptes Rendus*, 198. *pp.* 1889–1893, *May* 28, 1934.—The double refraction of O_2 and N_2 under pressure in a powerful magnetic field is studied with the aid of an apparatus previously described. In both cases the refraction is proportional to pressure but in O_2 it is about 12 times greater than in N_2. The feeble refraction of aqueous solutions of $NaClO_3$ and $Ba(ClO_3)_2$ is measured, the results being in agreement with those of Krishnan. H. J. H. S.

2841. Magnetic Rotatory Dispersion of Water in the Ultra-Violet. G. Bruhat. *J. de Physique et le Radium*, 5. *p.* 152, *April*, 1934.—Revised values are given for the Verdet constant of water for 9 values of λ between 4358 and 2482 Å, with those determined by Roberts and Miescher [see Abstracts 2794 (1930) and 1187 (1932)], all corrected (where necessary) so as to refer to $\rho_D = 0\cdot1309$ instead of to $\rho_D = 0\cdot1303$. Agreement is good, the differences not exceeding 1 %. [See Abstract 1125 (1934).] C. A. S.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

2842. Ultra-Violet Absorption and Fluorescence of Benzene Vapour. F. Almasy and C. V. Shapiro. *Zeits. f. phys. Chem.* 25. *Abt.B.* 5–6. *pp.* 391–398, 1934.—The fluorescence and absorption spectra of benzene have been photographed with a large dispersion instrument. Analysis of these spectra shows that in the region from 37486 to 35349 cm.$^{-1}$ in which they overlap, there is complete coincidence. The Tesla luminescent spectrum on the other hand differs appreciably. A further paper will deal with the bearing of this result on the structure of the benzene band system. J. E.

2843. Isotope Effect and Quenching in Bromine Fluorescence. H. J. Plumley. *Phys. Rev.* 45. *pp.* 678–684, *May* 15, 1934.—The fine structure of the resonance spectrum of bromine excited by the green line of the mercury arc has been photographed and a theoretical explanation obtained in terms of the three molecular isotopes present and the values of the rotational and vibrational quantum numbers for the transitions. In addition, the fluorescence intensities in bromine were studied as a function of the pressure, for three spectral regions. The much lower intensities in bromine as compared with iodine are accounted for on the basis of less initial absorption, and of greater quenching, due to the longer mean lifetime of the molecule in the upper state. The fluorescence data are concordant with results obtained in the analysis of bromine's absorption spectrum. The green mercury line did not excite any observable fluorescence in gaseous chlorine. This result is shown to be in accordance with the theoretical predictions. AUTHOR.

2844. Theory of Phosphorescence. D. Blochincev. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* **2.2.** *pp.* **76–81, 1934.** *In German.* —An attempt to explain phosphorescence in terms of quantum theory assuming that it is due to a return of electrons expelled from a centre. The existence of two kinds of centres is deduced, those of neutralised foreign metals and those of neutralised anions. A very approximate calculation has given (not reproduced in paper) a mean life of the centres of 10^{15} times the usual mean life of the excited state (10^{-8} sec.), It is considered that the decay of phosphorescence is determined, quite apart from any theory of recombination mechanism, by the usual law of bimolecular reactions, and the hyperbolic decay formula deduced from this has been confirmed experimentally in the author's laboratory. J. E.

2845. Active Nitrogen and the Auroral Spectrum. J. Kaplan. *Phys. Rev.* 45. *pp.* 671–674, *May* 15, 1934.—A new afterglow of nitrogen has been photographed in the visible and the near ultra-violet. Its spectrum consists of the first negative bands of N_2^+, first-positive bands of N_2 which originate on the vibrational levels $v' = 15, 16, 17, 18$ and 19, and the second-positive group of nitrogen. The ordinary afterglow of nitrogen is also present but very weak. The spectrum of the afterglow is a very faithful reproduction of that part of the auroral spectrum which is due to nitrogen. The spectrum of the exciting discharge resembles that of the afterglow very closely, These facts are used as a basis for the hypothesis that the auroral spectrum is the superposition of a discharge spectrum and an afterglow spectrum. Attention is called to proposed extensions of the experiments. [See Abstract 1393 (1933) and following Abstract.] AUTHOR.

2846. New Band System in Nitrogen. J. Kaplan. *Phys. Rev.* 45. *pp.* 675–677, *May* 15, 1934.—The measurements of the new band system of nitrogen, which were first reported in a recent note have been revised [see preceding Abstract]. The members of this band system are identical with members of the ϵ-system observed by Vegard in the luminescence of solid nitrogen. The revision was made possible by the successful photography of these bands on a spectrograph of larger dispersion than the one first used. The agreement between the lower state of these bands and the normal $X'\Sigma$ state of N_2 is very good, but there is no agreement between the upper state and the well-known metastable $A^3\Sigma$ state. The upper state, or the initial state in emission, corresponds to a new level of N_2, probably the ${}^3\Sigma$ level which is produced from two ${}^4S$ atoms. The bands of this system can be represented by the equation $\nu = 49{,}766 + (1460v' - 21v'^2) - (2345 \cdot 16v'' - 14 \cdot 445v''^2)$. The excitation of these bands is ascribed to the presence of vibrating nitrogen molecules in the afterglow, and it is proposed that these bands may be used as a test for vibrating nitrogen molecules in the normal electronic state. AUTHOR.

See also Abstract **2921.**

INTERFERENCE, DIFFRACTION AND SCATTERING.

2847. Interference Phenomena in Lenticular Films. J. Picht. *Zeits. f. Physik*, 88. 11–12. *pp.* 779–785, *May* 5, 1934.—The paper discusses the intensity distribution in the interference patterns formed with a film, one side of which has narrow cylindrical lenses ruled on it. The mathematical representation of the light distribution is obtained in the form of an integral and its application in a practical example is illustrated. [See Abstract 803 (1932).] W. D. W.

2848. Achromatic Interference Fringes with White Light. E. Rüchardt. *Phys. Zeits.* 35. *pp.* 453–454, *June* 1, 1934.—A simple method is described of producing colourless interference bands using a source of white light. The interference fringes are formed in a Lloyd single mirror system, but an image of a slit obtained with an uncorrected lens serves as the light source. By a suitable disposition of the mirror relative to the coloured image of the slit, it can be arranged that the fringe widths for each wave-length are practically equal. W. D. W.

2849. Secondary Interference Fringes. W. F. C. Ferguson. *J.O.S.A.* 24. *pp.* 157–158, *June*, 1934.—A dissonance phenomenon is observed to occur between two types of interference fringes: (1) those produced by stationary light waves formed in front of a mirror and made visible on a thin translucent film and (2) the fringes of equal thickness formed by the wedge of air enclosed between the thin film and the mirror. AUTHOR.

2850. Mounting of 21-ft. Rowland Concave Grating. W. Lochte-Holtgreven. *Manchester Phil. Soc., Mem.* 77. *pp.* 9–18, 1932–1933.—A full description is given of the mounting of a 21-ft. Rowland grating in a Runge-Paschen mount. The essential features are illustrated by means of photographs. Details of the adjustment are also given. A. H.

2851. Resolution of Gratings. K. Strehl. *Zeits. f. Physik*, 88. 9–10. *p.* 676, *May* 2, 1934.—In a short note the reproduction of gratings that are just below the limit of resolution, is discussed, with particular reference to the width of the openings in the grating relative to their separation. [See Abstract 183 (1934).] W. D. W.

2852. Radiational Reaction in Scattering by Free Electrons. I. Waller. *Zeits. f. Physik*, 88. 7–8. *pp.* 436–448, *April* 21, 1934.—Develops the theory of light scattering by free electrons taking Dirac's theory of radiation as basis but avoiding certain infinity difficulties which occur in the latter, by a device similar to that used by Weisskopf in the case of bound electrons. Expressions for the radiational damping and displacement of the Compton frequency are derived. W. S. S.

2853. Rayleigh's Law of Scattering in the Infra-Red. A. H. Pfund. *J.O.S.A.* 24. *pp.* 143–146, *June*, 1934.—The scattering is inferred from transmission measurements carried out on transparent particles of zinc oxide and other finely divided crystals. Rayleigh's law of scattering is obeyed for the smallest particles of $0\cdot088\mu$ diameter but not for larger particles. Conclusions as to particle size and size distribution are drawn from the transmission curves. The effect of varying the refractive index of the medium surrounding the particles on the transmission curves is found to be in accord, qualitatively, with Rayleigh's formula. AUTHOR.

See also Abstract 2876.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

2854. Photolysis of Silver Halides. P. Feldmann and A. Stern. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2. *pp.* 45–57, 1934.—By the method previously developed [see Abstract 3631 (1931)] the quantum yield of the photolysis of precipitated AgCl at 313 mμ in presence of nitrite as halogen-acceptor is found to be about 1, whereas that for crystalline AgCl in absence or presence of nitrite lies between 0·13 and 0·20. Precipitated AgBr in presence of $NaNO_2$ at 365 and 436 mμ gives the value about 1, and without $NaNO_2$ at 365 mμ, about 0·4; crystallised AgBr (from NH_3) with or without $NaNO_2$ gives also about 0·4. Plotnikow's objections against the use of $NaNO_2$ are found to be invalid. T. H. P.

2855. Photochemical Decomposition of Phosgene. C. W. Montgomery and G. K. Rollefson. *Am. Chem. Soc., J.* 56. *pp.* 1089–1092, *May,* 1934.—This decomposition has been studied kinetically and a reaction mechanism is proposed from which the rate law $-d(COCl_2)/dt = kI_{abs} - k^1I_{abs}^{1/2}(CO)^{1/2}(Cl_2)$ may be derived. This law represents the experimental data, and the mechanism is in accord with previous work. Almasy and Wagner-Jauregg's results [see Abstract 1003 (1933)] are discussed and a possible explanation of them suggested. T. H. P.

2856. Photographic Sensitivity after the Herschel Effect. J. M. Blair. *J.O.S.A.* 24. *pp.* 155–156, *June,* 1934.—The exposure of a photographic emulsion to a red light after exposure to a white light partially or wholly destroys the image formed by the exposure to white light. It has been variously stated that during the second exposure the photographic emulsion either regains most of its original sensitivity or that there is a considerable diminution in sensitivity after these exposures. The results given in this paper show that the exposure to white light followed by exposure to red light does not affect the sensitivity of the emulsion. It is shown that the densities produced by pre-exposure, bleaching and re-exposure are definitely higher than those obtained with normal exposure, the differences being due to the residual density from the pre-exposure, so that the original sensitivity is fully regained in the case of the one emulsion examined. R. C. F.

2857. Improvements in the Schlieren Method of Photography. H. C. H. Townend. *Journ. Sci. Instruments,* 11. *pp.* 184–187, *June,* 1934.—A simple arrangement of light source and diaphragm stop is described for use in the Schlieren method of photography which is of special use when a dark background is required. The image, instead of being shaded on one side and bright on the other, is bright on both sides. This gives more light and makes the image symmetrical, features which are of importance in special cases. [See Abstract 182 (1934).] AUTHOR.

2858. Photogenic Value of the Electric Spark. L. Bull. *Rev. d'Optique,* 13. *pp.* 9–16, *Jan.,* 1934.—The value of the spark as a source of illumination for photographic purposes is determined by comparing the photogenic value of the spark with that of the arc. In order to make the comparison it is essential to determine the exposure time necessary, with the arc, to produce the same photographic blackening as is obtained with the spark. The method is described, the spark having a length of 1·5 mm, and the capacitance a value of 0·0005 mfd., charged to 5000 volts. Aluminium electrodes are used as there is no halo such as is obtained with magnesium and iron-electrodes, although the brightness with aluminium electrodes is much lower than with silver electrodes, the latter showing only a faint small halo. The time of duration of the spark varies with the different electrodes, being 10^{-7} sec. with silver and aluminium electrodes, 2×10^{-6} sec. with magnesium, and 3×10^{-6} sec. with iron electrodes. An exposure time of approximately 1/20000 sec. is necessary to give the same blackening as with the spark so that photographically the brightness of the spark is certainly more than 500 times that of the arc. R. C. F.

2859. Rotating Flashometer. W. E. Forsythe and M. A. Easley. *Rev. Sci. Instruments,* 5. *pp.* 216–217, *June,* 1934.—Describes the construction and operation of a flashometer with a rotating film drum which has been developed for the study of the time characteristics of photo-flash lamps. The necessary time scale is put on the film in the same manner as the time scale was put on the plate of the falling plate flashometer [see Abstract 807 (1932)]. Other uses of the instrument are briefly described, these being the study of the various time characteristics of a number of tungsten lamps, the checking of the time characteristics of certain camera shutters, and the checking of devices for synchronising the opening of the shutter of the camera with the flash of a photo-flash lamp. R. C. F.

See also Abstracts 2759, 2878, 2971, 3017.

PHOTOMETRY.

2860. Photon Counters. Part I. Different Types. B. Rajewsky. *Ann. d. Physik,* 20. 1. *pp.* 13–32, *May,* 1934.—By " photon counter " is meant a form of Geiger-Müller counter adapted to the counting of photons ; it has a suitably transparent window and embodies a photoelectrically active surface, from which the emission of electrons causes the counter to discharge in the usual way. This paper describes a number of different forms which the author has developed to suit different conditions of experiment. [See Abstracts 2421 (1931) and 1121 (1934).] D. H. F.

2861. Lucimetric Index by Means of a Helio-Chromometer. Bordier. *Comptes Rendus,* 198. *pp.* 1810–1812, *May* 14, 1934.—The helio-chromometer comprises a quartz test tube containing a standard solution of iodoform in chloroform which on exposure for a fixed time to daylight or sunlight becomes coloured owing to the liberation of free iodine. The resulting coloration is compared with that of a series of twelve similar tubes containing solutions of iodine in chloroform of different concentrations. In this way the lucimetric index (weight of iodine liberated per min.) is determined. A difficulty is that once the liberation of iodine from the iodoform is started it tends to continue even when the tube is kept in the dark. Thus the slightest accidental exposure of the test solution is sufficient to make it useless for measurement purposes. W. S. S.

2862. Photoelectric Photometer for Reaction-Kinetic Measurements. G. Brauer. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2. *pp.* 71–80, 1934.—For the photometric determination of rapid changes in concentration, photoelectric arrangements with optical compensation by the null-point method are unsuitable. A photometer is described which, with two photoelectric cells, alternating light, and resistance reinforcement, attains an accuracy of 0·05 %. It has the advantage of permitting use in a lighted room, even when spectrally pure measuring light of low intensity is used. T. H. P.

2863. Photographic Methods of Determining the Daylight and Sunlight within Buildings. H. E. Beckett. *Phot. J.* 74. *pp.* 229–237 ; *Disc,* 238, *May,* 1934.—Considers the measurement of daylight and sunlight separately, as the radiation from the sun is used in several different ways. After briefly discussing the importance of the daylight factor, photographic methods of measuring it are dealt with. The various methods first described possess certain disadvantages, and these, together with simplifications and assumptions introduced, resulted in the development of graphical methods of measuring daylight factors. A logical development of the graphical process for use in existing buildings is to obtain the flat projections of the windows photographically, methods using a lens camera being briefly discussed. Owing to the disadvantages of the lens camera, a pinhole camera is described which is capable of taking pictures to within 5° of the horizon, the necessary daylight factor grid, drawn on Kodatrace, being impressed photographically on the picture before development. Finally, the use of the pinhole camera for sunshine measurements is described, cylindrical projections of sunpaths at various times of the year being superposed instead of the daylight factor grid. In the *Discussion* **A. C. Banfield** mentioned the lens invented by Hill for the especial purpose of sky photography, and **E. R. Davies** suggested the use of an old type of photometer with opal glass. In his reply the author describes the making of a tissue paper wedge. R. C. F.

2864. Errors in Photographic Photometry. J. T. Lay and I. C. Cornog. *J.O.S.A.* **24.** *pp.* 149–154, *June*, 1934.—The chief sources of error in the photographic method of comparing light intensities of the same wave-length are the variations in density over the plate caused by its irregular structure and its uneven development. The causes and magnitudes of these errors are studied by exposing plates to a field of illumination the degree of whose uniformity of intensity is measured with a photoelectric-cell and amplifier. The main objections and difficulties ordinarily associated with the photographic method are briefly discussed, and methods are suggested for their control and correction. AUTHORS.

2865. Ultra-Violet Photoelectric Spectrophotometer. D. H. Follett. *Phys. Soc., Proc.* 46. *pp* 499–507 ; *Disc.* 507–509, *July* 1, 9134.—An instrument designed for accurate spectrophotometry is described. The transmission of the sample is found by comparison with a rotating sector, which is of cylindrical type and meets the criticisms usually directed against sectors, whose transmission can be varied while they are running. Two photoelectric cells are employed and fluctuations in the intensity of the source are compensated for. The possible sources of error and their elimination are discussed and the results of tests are given. AUTHOR.

See also Abstracts **2838, 3067.**

POLARISATION.

See Abstract **2740.**

RADIATION, EMISSION.

2866. Free-Balloon Cosmic Ray Intensity Measurements. G. A. Suckstorff. *Phys. Zeits.* 35. *pp.* 368–372, *May* 1, 1934.—The results obtained by a free-balloon flight in March, 1933, are given and discussed. Up to 7000 m. the agreement with Kolhörster's 1913–1914 results is good, but at greater heights the measurements show greater intensities. Also, the intensity curve shows pronounced irregularities, which increase with the height. These irregularities are attributed to an

"air-radiation," which the author concludes is associated with certain meteorological conditions. The difference at the higher altitudes between these and Kolhörster's measurements is attributed to the same cause.
D. H. F.

2867. Corpuscular Component of Cosmic Radiation. T. H. Johnson. *Phys. Rev.* 45. *pp.* 569–585, *May* 1, 1934.—The directional distribution of cosmic radiation has been investigated at different heights at various geomagnetic latitudes. The west intensity was always greater than the east; quantitative results on the degree of asymmetry were consistent with the presence of a primary corpuscular component, exclusively positively charged. This component is identified with the intense soft component deduced by Millikan and Regener from absorption-curve analyses. Further experiments resulted in the identification of this component with the shower-producing radiation. Experiments at high elevations showed that a relatively soft ionising radiation is produced intermediately in the production of showers. It was shown that the ratio of counts to electroscope ionisation is less for the soft than for the harder components and a correction for this effect, which probably arises from shower-production, brings zenith-angle distributions into fair agreement with the absorption curve analysis of Bowen, Millikan and Neher. The existence of a radial cosmic electric field, with the earth near its centre, is suggested in an attempt to account for an exclusively positive corpuscular component.
D. H. F.

2868. Coincidence Measurements of Latitude Variation of Cosmic Rays. L. Leprince-Ringuet and P. Auger. *J. de Physique et le Radium*, 5. *pp.* 193–198, *May*, 1934.—Measurements were taken on a voyage between latitudes 40° N. and 38° S. The intensity at the equator was found to be about 15 % less than at the extreme latitudes. At the equator the distribution about the vertical showed an asymmetry, intensities being rather greater from the east than from the west, but at 38° S. no asymmetry was established. It could not be established that there was any variation with latitude of the penetrating power, as measured with 20 cm. blocks of lead between counters arranged vertically.
D. H. F.

2869. Constitution of Cosmic Rays. A. Piccard. *Comptes Rendus*, 198. *pp.* 1683–1685, *May* 7, 1934.—It is suggested that cosmic radiation consists of (*a*) electromagnetic radiation of which that with $h\nu > 10^6$ e.v. is absorbed by the nuclei of the atoms of the upper atmosphere, resulting in materialisation of rapid electrons and positrons, and that these form the greater part of the cosmic radiation observed at the surface of the earth; and (*b*) corpuscular radiation from extra-terrestrial space, the presence of which explains the small variation observed in ionisation with magnetic latitude.
C. A. S.

2870. Sources of Black Body Radiation. T. N. Panay. *J. de Physique et le Radium*, 5. *pp.* 171–178, *April*, 1934.—This paper describes sources of black-body radiation designed to act as comparison sources in spectral intensity measurements. In one the radiator is a small carbon tube in an atmosphere of argon, heated by the passage of a large electric current; the inner wall of the tube is used as the radiating surface and is viewed through a hole in the side of the tube. The tube is mounted in a pyrex envelope. It is heated by means of a transformer of which the secondary, consisting of five turns of heavy stranded copper wire, is connected to the tube and is contained in a helical pyrex tube sealed into the main envelope. To obtain a black-body at a fixed temperature, boiling zinc has been utilised; it is heated electrically in a tube of fused quartz and the radiating surface is the inside of a fused quartz sphere at the end of another cylinder mounted coaxially with the first. An arrangement has also been attempted using boiling lead; carbon then takes the place of the fused quartz. D. H. F.

2871. Temperature Radiation in Spark Discharges. W. Finkelnburg. *Zeits. f. Physik*, 88. 11–12. *pp.* 763–767, *May* 5, 1934.—The conditions for the emission of black-body radiation by gases are investigated. The gas must be in thermodynamic equilibrium and the extension of the radiating mass of gas must be large compared with the maximum optical depth, under the given conditions, for the emission of black-body radiation to be possible. These conditions are not fulfilled in spark discharges. The continuous spectra emitted by spark discharges must therefore be ascribed to a primary process giving direct continuous emission (continuous electron radiation). J. E. K.

2872. Continuous Electron Radiation in Spark Discharges. W. Finkelnburg. *Zeits. f. Physik*, 88. 11–12. *pp.* 768–778, *May* 5, 1934.—Comparison of the continuous spectra emitted by spark discharges of all kinds—in liquids and gases, under increased or reduced pressure—shows that there is agreement between all the properties of these continua. The properties of the continua agree in all respects with those to be expected for continuous electron radiation. Hence continuous spark spectra such as the continuous under-water spark spectrum, the continuous spectra of exploded wires and the Lyman-Anderson vacuum spark continuum must be interpreted as continuous electron radiation. J. E. K.

2873. Spectral Sensitivity of Radiations from High- and Low-Pressure Hg Arcs. B. T. Barnes. *J.O.S.A.* 24. *pp.* 147–148, *June*, 1934.—Data have already been published regarding the energy radiated in certain strong lines and in the four broad regions of the spectrum from low and high-pressure Hg arcs [see Abstract 1888 (1933)], in ultra-violet, and in the infra-red regions of the spectrum from a high pressure arc. These results, however, are not strictly comparable owing to differences in operating conditions and the different arc tubes used. Results obtained with Uviarc and Cooper-Hewitt tubes designed for horizontal operation are given in the present paper and deal with the intensities of all the ultra-violet, visible, and infra-red lines easily measurable with a single spectro-radiometric outfit. Only one tube of each type was used, the density of the energy flux from the entire arc being given for high-pressure Hg vapour tubes, whilst for the low-pressure tubes the energy density per metre of arc length is recorded. R. C. F.

See also Abstracts 2805, 2815, 2858, 2950, 3012.

RADIATION, GENERAL THEORY.

2874. Intrinsic Energy of the Electron. V. Weisskopf. *Zeits. f. Physik*, 89. 1–2. *pp.* 27–39, May 15, 1934.—An expression for the intrinsic energy of the electron is derived without direct application of quantum mechanics but in terms of the classical theory and with the aid of the Heisenberg radiation theory. A general calculation is also given for a multi-electron system and evaluated for the case in which all the electrons are in a negative energy state. The resulting degree of divergence of the intrinsic energy is the same as in the ordinary single electron theory, and is not reduced by application of the concept of the negative energy condition. H. F. G.

2875. Statistics of Positrons and Electrons in Equilibrium with Radiation at High Temperatures. G. Wataghin. *Phil. Mag.* 17. *pp.* 910–913, *May*, 1934.—Considers the statistics of positrons and electrons at sufficiently high temperatures for the photons to be capable of generating positron-electron pairs by collision with nuclei. Since the number of particles varies with the temperature the Fermi-Dirac statistics are modified. It is shown that, neglecting any forces of interaction between positrons and electrons, the densities of these particles are proportional to the cube of the temperature. The effect of interaction forces is shown not to influence sensibly the results obtained assuming negligible interaction. The processes considered may be of importance for the temperatures existing inside some stars. W. S. S.

2876. Radiation Emitted in Collisions with Very Fast Electrons. C. F. v. Weizsäcker. *Zeits. f. Physik*, 88. 9–10. *pp.* 612–625, *May* 2, 1934.—The emitted radiation is calculated in the coordinate system in which the colliding electron is initially at rest. The Coulomb field of the passing atomic nucleus that has taken part in the collision may then be regarded as a field of radiation: the emitted radiation is the amount scattered according to the Klein-Nishina formula. The result is identical with that obtained earlier (within the limits of approximation used). A detailed physical interpretation accompanies the calculations. H. L. B.

See also Abstracts 2764, 2852, 3020.

RADIATION, MECHANICAL EFFECTS.

2877. Decay of Charge and Electrophotophoresis. A. Lustig and M. Reiss. *Phys. Zeits.* 35. *pp.* 340–344, *April* 15, 1934.—The authors bring forward theoretical and experimental reasons for challenging Sitte's conclusions [see Abstract 4075 (1933)]. **K. Sitte,** *ibid. pp.* 345–346, replies, re-stating his position, which he avers has been misunderstood by the authors through his own inadequacy of exposition. A. D.

See also Abstract 2993.

REFLECTION. REFRACTION AND DISPERSION.

2878. Reflection Density Meter. W. B. Ferguson and S. Read. *Phot. J.* 74. *pp.* 249–251, *May*, 1934.—Reflection density is defined as the logarithm of the ratio of incident light to reflected light, the instrument to measure these lights making use of the principle that the illumination of any surface varies inversely as the square of the distance of the light from that surface. The two tints to be compared are arranged at the two ends of the hypotenuse of a right-angled triangle, both being illuminated by a small electric lamp capable of being moved along the straight line connecting the tints by means of a graduated rod. In order to compare the illuminated fields a photometer cube is placed at the other corner of the right-angled triangle and is viewed by means of a magnifying focussing eyepiece, the tints being illuminated at angles of 45° and observed perpendicularly to their surfaces. The whole instrument is enclosed in a dead black box with suitable baffle screens, prism box, and diaphragms arranged so that stray light does not interfere with the results. Finally, additional points are discussed, these being method of use, construction of a chart to avoid the logarithmic calculation for each measurement, correction for instrumental error, and measurement of a reflection density higher than 1·6. R. C. F.

2879. Molecular Refractivity of Sodium Chloride. F. H. Newman. *Phil. Mag.* 17. *pp.* 1072–1075, *May,* 1934.—Discusses molecular refractivity of NaCl, in solution or crystalline, and compares experimental estimates of the refractivity with values derived from wave-mechanics screening constants for the component ions. It appears that ions in solution are more similar to gaseous ions than ions in crystals in regard to refractivity. New measurements of molecular refractivity of NaCl in solution give the value 9·05 (D lines, 18°C.) for infinite dilution. W. S. S.

2880. Apparent Molecular Volume and Refraction in Dilute Solutions. W. Geffcken and D. Price. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2. *pp.* 81–99, 1934.—By means of accurate methods previously described [see Abstract 181 (1934)] for the determination of density and refractive index, the apparent molecular volumes and molecular refractions have been found for dilute solutions of NaBr, KCl, NH_4NO_3, Na_2SO_4 and Na_2CO_3. The concentration-dependence below normality is briefly explained. By combining propositions from the classical dissociation theory with a relation derived by Redlich and Rosenfeld from the Debye theory of electrolytes, the contours of the molecular volume-concentration curves are also theoretically indicated for average strengths and for hydrolysing electrolytes. The special cases chosen for quantitative treatment of the former electrolytes are H_2SO_4 and H_3PO_4, with Na_2CO_3 for the latter. The question of definite ionic-combinations is discussed from the standpoint of the data obtained. H. H. Ho.

2881. Optical Examination of Thin Films. Part I. Optical Constants of Mercury. L. Tronstad and C. G. P. Feachem. *Roy. Soc., Proc.* 145. *pp.* 115–126, *June* 2, 1934.—The values of the optical constants of mercury have been measured for λλ 4350, 5460, and 5780 Å. The values are discussed in relation to previously published values for wave-lengths in the visible region of the spectrum [see following Abstract]. AUTHORS.

2882. Optical Examination of Thin Films. Part II. Films of Fatty Acids on Mercury. C. G. P. Feachem and L. Tronstad. *Roy. Soc., Proc.* 145. *pp.* 127–135, *June* 2, 1934.—The behaviour of several fatty acids as films on mercury has been studied by the method of examining the surface in polarised light. It is found that: (1) The acids spread with extreme difficulty to give films, the shorter-chain acids spreading more readily than the longer. (2) The films can exist in three phases, with molecular areas as follows: Solid, up to 22 Å^2; liquid, 22 to 45 Å^2; expanded, from 45 Å^2. Of these phases only the solid and expanded are ultimately stable. (3) Homogeneous films of expanded phase can be prepared and compressed through the liquid phase, sometimes up to 22 Å^2 per molecule. It is concluded that the method is amply sensitive to measure unimolecular and other thin films, but better suited to examine adsorption. [See preceding Abstract.] AUTHORS.

2883. Optical Properties of the Spectroscope. F. Croze. *Rev. d'Optique,* 13. *pp.* 1–8, *Jan.,* 1934.—Formulæ for the angular magnification and the dispersion of a prism or system of prisms are derived by differentiating an equation which expresses the fact that the optical paths between two wave surfaces are equal for any two rays. The principle of the method is due to Rayleigh. The formulæ obtained are expressed in terms of the angles of incidence and emergence of a parallel bundle of rays passing through the prism system. W. D. W.

2884. Optical Properties of the "van Leeuwenhoek" Microscope at Utrecht University. P. H. van Cittert. *K. Akad. Amsterdam, Proc.* 37. 5. *pp.* 290–294, 1934.—Examination of the magnification and resolving power of all the 18th and 19th century simple and compound microscopes at Utrecht University shows that up to early in the 19th century only the construction and mechanical arrangement of these microscopes were improved and the optical capacities hardly altered. During this period the simple microscope was the better type. Use of the achromatic objective led to an increased resolving power of the compound microscope and from 1830 it became the better type. A diagram illustrates these facts by showing the resolving power in mm. and magnification of several types and the great advantage possessed for a long time by the van Leeuwenhoek simple microscope made in 1700. R. S. R.

2885. Photoelectric Eyepiece for Measurement of Reflecting Power of Opaque and Transparent Minerals and for Metals and Alloys. J. Orcel. *Rev. d'Optique,* 13. *pp.* 58–62, *Feb.,* 1934.—A Scad photoelectric cell is used and fitted into the eyepiece of a metallographic microscope, and a diagram illustrates the action of the eyepiece. Only a very small surface is needed for measurement and the method is thus very useful when several constituents exist in the mineral. A direct comparison of the polished surface is made with a standard for which purpose a diamond, yellow blende or silicon is used. Errors in measurement do not exceed 1 %. R. S. R.

See also Abstracts 2815, 2851, 2857, 2942, 2943.

SPECTROSCOPY.

2886. Wave-Lengths and Terms in the Fluorine Spectra, F VII and F VI. B. Edlén. *Zeits. f. Physik,* 89. 3–4. *pp.* 179–182, *May* 24, 1934.—Beryllium or graphite rods filled with LiF were used as spark electrodes and the spectrum photographed with a 1-m grazing incidence grating and a large quartz spectrograph. Term analysis was made by analogy with the homologous spectra of C, N and O. Tables of wavelengths and terms are given. The ionisation potentials for the F VII and F VI spectra are found to be 184·261 and 156·369 volts respectively. F. S.

2887. Infra-Red Spectrum of Argon. R. M. Woods and B. J. Spence. *Phys. Rev.* 45. *pp.* 669–670, *May* 15, 1934.—A hot kathode discharge tube permitting a discharge current of up to 10 amperes is described. This tube was used as the source for an investigation of the infra-red spectrum of argon. Forty-six lines between 0·69μ and 1·80μ are listed. Twenty of these lines have never been observed before. AUTHORS.

2888. Sr II and Ba II Spectra. F. A. Saunders, E. G. Schneider and Emily Buckingham. *Nat. Acad. Sci., Proc.* 20. *pp.* 291–296, *May,* 1934.—The work of Lyman on the spectra of Ba II and Sr II in the Schumann region is extended. As source a d.c. vacuum arc between the metal and a graphite electrode is employed, the spectra being photographed by means of a 1-m. vacuum grating spectrograph. Another source employed consists of a quartz electrical furnace filled with the metallic vapour through which a h.t. transformer discharge passes, both with and without an external spark gap. The results for Ba II are practically identical with those of Rasmussen. The Sr II spectrum is found to be regular in every way and similar to that of Ca II. A. H.

2889. Absorption Spectrum of the Iodine Atom. J. H. McLeod. *Phys. Rev.* 45. *pp.* 802–804, *June* 1, 1934.—The absorption spectrum of atomic iodine has been investigated in the spectral range 2100 to 1400 Å. The iodine was dissociated by heating to 1000° C. A hydrogen discharge tube or an iodine discharge tube was used as the source of illumination. The former source revealed clearly that 1830 and 1783 Å are absorption lines. When light from a discharge in iodine was passed through the heated iodine the following lines were found to be weakened by absorption, 1830, 1783, 1642, 1618, 1583, 1515, 1507 and 1422 Å. AUTHOR.

2890. Br IV Spectrum. A. S. Rao and S. G. Krishnamurty. *Phys. Soc., Proc.* 46. *pp.* 531–536, *July* 1, 1934.—Vacuum spark and discharge-tube spectra of bromine have been investigated over a wide range. Many of the triplets and singlets involving the terms due to $4p$, $5s$, $4d$, sp^3 and $5p$ configurations have been identified. From the present work the classifications made by Deb [see Abstract 3131 (1930)] appear to be incorrect. The deepest term $4p^3P_0$, which equals 404892 cm.$^{-1}$, yields an ionisation potential of about 50 volts for the trebly-ionised atom of bromine. AUTHORS.

2891. Anomalous Increase in Intensity of the Mercury Line 5461 Å in Discharge through a Mixture of Nitrogen and Oxygen. N. Prileshajewa. *Zeits. f. Physik,* 89. 1–2. *pp.* 24–26, May 15, 1934.—In connection with the recent publications of Güntherschulze and Betz [see Abstracts 3552 and 4505 (1933)] a short account is given of observations of an anomalous increase in intensity of the Hg line 5461 Å in a discharge through a mixture of nitrogen and oxygen. The mercury vapour is derived from the manometer used. The fact that the Hg lines 4358 and 4047 Å do not show the increase in intensity under the conditions of the experiment is explained as due to their absorption by NO_2 formed in the discharge. Under otherwise similar conditions no Hg lines are observed with oxygen alone or nitrogen alone. L. A. W.

2892. Nuclear Mechanical Moment of Lanthanum from Hyperfine Structure. O. E. Anderson. *Phys. Rev.* 45. *pp.* 685–688, *May* 15, 1934.—The hyperfine structure of the lines λλ5212, 5234 and 6250 of LaI has been observed with a flint glass spectrograph crossed with Fabry-Perot étalons. A liquid-air cooled Schüler tube was used as a source. The number of components, the intensity ratios and the interval spacing are all in good agreement with the value $I = (7/2)\,(h/2\pi)$ for the nuclear mechanical moment. AUTHOR.

2893. Hyperfine Structure of the Zinc Resonance Line 3076 Å. W. Billeter. *Helv. Phys. Acta,* 7. 4. *pp.* 413–426, 1934. *In German.*—The hyperfine structure of the zinc resonance line 3076 Å ($1\,S - 2^3P_1$) is investigated by the absorption method. From the resonance curves obtained it is concluded that the line has no hyperfine structure components with intensities comparable to that of the main line at a distance of more than $\delta\lambda = 3 \times 10^{-4}$ Å from the main line. J. E. K.

2894. Mean Life of a Spectroscopic Term and Width of Spectral Lines. I. I. Agarbiceanu. *Comptes Rendus,* 198. *pp.* 1484–1486, *April* 23, 1934.—The width of spectral lines and the instability of an atomic or molecular energy configuration can be related on the basis of the Heisenberg uncertainty principle. Particles raised to a higher quantum level by the absorption of light will oscillate in their new state about a minimum potential energy. The energy oscillations show differences of phase arising from the time interval occupied by the absorption. For a sufficiently long mean life in the active state there will be a configuration of particles at the state corresponding to minimum potential energy. The combination of two such levels will give a narrow line. If, however, the mean life in a particular state is short relative to the decay of the oscillations the energy band will be wide and the corresponding lines broad. N. M. B.

2895. Effect of the Polarisation of the Inner Electron in the Field of the Outer Electron upon the Spectral Terms of a Two-Electron System (in particular He). G. Ludwig. *Helv. Phys. Acta*, 7. 3. *pp.* 273–284, 1934. *In German.*—This paper, which is wholly mathematical, gives an extension of the calculations of Bethe (*Handbuch der Physik*, 24. *p.* 339 *et seq.*, 1933) upon the Stark effect of the inner electron in the field of the outer electron. Numerical results are worked out for the ortho and para terms (2P and 3D) of helium. The agreement with observation is satisfactory for the 3D terms but not for the 2P terms. L. A. W.

2896. New Band System of Tin Oxide. F. W. Loomis and T. F. Watson. *Phys. Rev.* 45. *pp.* 805–806, *June* 1, 1934.—A new band system of SnO with origin at 36,803 cm.$^{-1}$ has been observed in an arc at reduced pressures. The lower state of this system is identical with that of the known *A* and *B* systems. The upper state is new and has a vibrational frequency, $\omega_e = 497 \cdot 8$ cm.$^{-1}$. The complexity of the isotope effect prevents rotational analysis. AUTHORS.

2897. Ultra-Violet Absorption of Heavy Water Vapour. J. Franck and R. W. Wood. *Phys. Rev.* 45. *pp.* 667–668, *May* 15, 1934.—The absorption spectrum of the vapour of normal and heavy water has been examined in the ultra-violet down to 1450 Å. The long wave-length limit of the continuous absorption band is shifted towards shorter wavelengths in the case of heavy water. Comparison with theory is made. AUTHORS.

2898. Ångström Bands of CO. D. Coster and F. Brons. *Physica*, 1. *pp.* 634–648, *May*, 1934. *In English.*—Perturbations occurring in the vibrational levels $v = 0, 1, 2, 3$ and 4 of the final state $A\ {}^1\Pi$ of the Ångström bands could be classfied as due to the known states $a'^3\Sigma^+$ and $d^3\Pi$ and to hitherto unknown states $e^3\Sigma -$ and a ${}^1\Pi$-state. A new band origin formula for the Ångström bands in agreement with our conception of the perturbations could be computed. The dissociation energy for CO of 9·82 volts formerly given has to be revised; 8·41 volts seems to be a better value. [See Abstract 1602 (1934).] AUTHORS.

2899. Investigations in the Infra-Red Region. Part X. Asymmetrical Nitrosyl Chloride. C. R. Bailey and A. B. D. Cassie. *Roy. Soc., Proc.* 145. *pp.* 336–344, *June* 2, 1934.—The infra-red absorption spectrum of nitrosyl chloride, NOCl, has been examined from 1 to 18 μ. Five bands were isolated between 4 and 16 μ, but as a consequence of the expected asymmetry of the molecule, no resolution was obtained. The molecule falls into the sulphur dioxide class, having a vertical angle of some 140°, and obeying a valence force system. The force constants have been determined and associated with the heats of linking. [For Part IX see Abstract 4935 (1933).] AUTHORS.

2900. Spectra of Indium Halide Vapours. M. Wehrli and E. Miescher. *Helv. Phys. Acta,* 7. 3. *pp.* 298–330, 1934. *In German.*—The emission and absorption spectra of InCl, InBr and InI are investigated by means of a quartz spectrograph and also by a grating (in the third order). The bands are analysed. In addition to the isotopes of Cl and Br very small traces of a hitherto unknown isotope of indium (113) are found. The spectrum of each salt consists of 3 systems A, B and C, which all have the same ground state. The system of shortest wave-length (C) occurs much more intensely in absorption than A and B. Detailed tables are given and also photographs of the spectra. H. L. B.

2901. Spectra of Gallium Halide Vapours and Gallium Oxide. M. Wehrli and E. Miescher. *Helv. Phys. Acta,* 7. 3. *pp.* 331–359, 1934. *In German.*—GaCl, GaBr, and GaI give analogous spectra to those obtained for the corresponding indium salts [see preceding Abstract]. In addition to the isotopes of the halides those of gallium (69 and 71) are also observed. All three systems have the common ground system ($^1\Sigma_0^+$) and are interpreted as the transitions: $^1\Pi_1 - {}^1\Sigma_0^+$ (C), $^3\Pi_1 - {}^1\Sigma_0$ (B), $^3\Pi_0^+ - {}^1\Sigma_0^+$ (A). The following dissociation values are obtained: GaCl 4·9, GaBr 4·1, GrJ 3·3 volts. A comparison is made of the data for gallium, indium and tellurium halides, and certain empirical rules are deduced. An appendix contains data and the analysis of a new spectrum, ascribed to GaO, which is emitted when gallium is burned in an oxyhydrogen flame. H. L. B.

2902. Molecular Spectra of Boron and Aluminium Halides. E. Miescher. *Helv. Phys. Acta,* 7. 4. *pp.* 462–464, 1934. *In German.*—A preliminary communication of the results of a detailed analysis of the visible and near ultra-violet bands of the chlorides, bromides and iodides of B and Al. A table of molecular constants, deduced from analysis of the bands, is given. J. E. K.

2903. Band Spectrum of Ionised Aluminium Hydride. W. Holst. *Zeits. f. Physik,* 89. 1–2. *pp.* 40–49, May 15, 1934.—The bands produced in the neighbourhood of 3600 Å when a discharge is passed through a mixture of aluminium chloride vapour and hydrogen have been examined under a dispersion of 0·95 Å per mm. In the blue part of the spectrum there appear not only the $^1\Pi \rightarrow {}^1\Sigma$ bands at 4240 Å and the $^1\Sigma \rightarrow {}^1\Pi$ bands at 4750 Å but also new bands attributable to the AlCl molecule. The bands at 3600 Å exhibit two edges shading towards the violet; each line is single and six branches have been observed, that nearest the violet showing indications of predissociation. The system is ascribed to the $^2\Pi \rightarrow {}^2\Sigma$ transition, the first term being $^2\Pi_i$ (reversed). The levels are compared with those in the magnesium system. Between 2550 Å and 2900 Å there is a pronounced band spectrum arising from the AlCl molecule; it appears to consist of several band systems and has not yet been completely examined. H. F. G.

2904. Band Spectrum of Aluminium Chloride. B. N. Bhaduri and A. Fowler. *Roy. Soc., Proc.* 145. *pp.* 321–335, *June* 2, 1934.—A band system having its greatest intensity at 2610 Å has been photographed with high dispersion in vacuum tubes containing the vapour of aluminium chloride. The system extends from 2855 Å to about 2810 Å, and with a few important exceptions, the bands are degraded to the red. The heads of the bands occur in pairs which have been interpreted as representing R and Q branches. Along with the main bands due to the lighter molecules $AlCl^{35}$ there are associated bands which originate in the heavier molecules AlCl^{37} and are displaced in accordance with theoretical expectation. An unusual feature of the band system is the occurrence of two short sequences of bands which are degraded away from the red, in opposition to the remaining bands. These have low vibrational quantum numbers and are of correspondingly high intensity. The close agreement with the positions calculated for them, together with the displacements of the accompanying isotope heads, shows that these bands are part of the same system as the bands which are degraded to the red. The vibrational analysis and the discussion of the isotope bands combine to prove that the band system under investigation originates in the diatomic molecules AlCl^{35} and AlCl^{37}. AUTHORS.

2905. Temperatures Indicated by Intensity Distributions in Band Spectra. O. S. Duffendack, R. W. Revans and A. S. Roy. *Phys. Rev.* 45. *pp.* 807–814, *June* 1, 1934.—It is generally supposed that the intensity of any particular line in a band spectrum may be calculated from the Maxwell-Boltzmann law, assuming the gas to be in temperature equilibrium. From the results of this experimental work, it appears that under some conditions of excitation other factors than the temperature of the gas govern the intensity distribution. Measurements on the negative bands of N_2^+ excited in low voltage arcs in the pure gas show that at 1100° K and 2800° K the distribution of intensities among the rotational lines is exactly the same, whilst the admixture of He with N_2 alters the distribution completely and gives a much lower indicated temperature. Similar results are found with the first negative bands of CO^+. The differences are accounted for by the conversion of translational energy of the electrons into rotational energy of the molecules when the bands are excited by electron impacts in the pure gas. When the bands are excited by impacts of the second kind in gas mixtures, no change in rotational energy occurs and thus the indicated temperature is much lower. The distribution of intensity among the vibrational states of the molecules has been examined for the complete system of negative bands of N_2^+. While almost all of the energy is concentrated in the low vibration states when the bands are excited by electron impacts, the energy is spread out towards the higher vibration states when the excitation is by collisions of the second kind with metastable He atoms. AUTHORS.

2906. Luminosity of Shock Waves. A. Michel-Lévy and H. Muraour. *Comptes Rendus,* 198. *pp.* 1760–1762, *May* 14, 1934.—The luminosity observed when the detonation wave from exploding lead azide strikes a solid body such as a copper cylinder or a cotton thread has been subjected to a preliminary spectroscopic examination. A continuous spectrum, extending far into the ultra-violet and showing reversed lines of lead and sodium, is observed; it resembles that produced by the almost instantaneous evaporation of a metallic wire. H. F. G.

2907. Absorption Spectra of Molecules. P. K. Sen-Gupta. *Zeits. f. Physik,* 88. 9–10. *pp.* 647–660, *May* 2, 1934.—From considerations of the shapes of the Franck-Condon curves an explanation is given of the discrepancies generally observed between the term values of an atom, derived on the one hand from its emission spectra and on the other hand from the differences between the long-wave limits of the continuous absorption regions of molecules which decompose as a result of light absorption giving rise to the atom in one or other excited state. Condon's theory of the extent of the continuous absorption in halogens is extended to the case of compounds which show further regions of absorption separated by regions of transmission. An analysis of the absorption curves of the alkali halides into overlapping components is suggested. Similar considerations provide an explanation of the absence of a region of transmission on the short-wave side of the absorption limit in the case of HBr and of HI, and support the view that the linkages in these molecules are of the ionic type. L. A. W.

2908. Zeeman Effect in Diatomic Molecular Spectra. F. H. Crawford. *Rev. Modern Physics*, 6. *pp.* 90–117, *April*, 1934.—Reviews the position now attained in the study of the Zeeman effect in diatomic molecular spectra. Following a discussion of the theory of the splitting of atomic and molecular levels several specific cases are dealt with in detail. The cases considered are the effects in diatomic molecular spectra of the following types : (1) singlet, (2) multiplet, (3) $^2\Sigma \rightarrow {}^2\Sigma$, (4) doublet states intermediate between Hund's case (*a*) and case (*b*), (5) singlet cases with L-uncoupling. The application of Hill's theory to typical doublet bands is dealt with and the experimental results for doublet type bands are discussed. The Zeeman effect near perturbations is also considered. A. H.

2909. Raman Effect at Low Temperatures. H. Epstein and W. Steiner. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2, *pp.* 131–158, 1934.—A detailed description is given of an apparatus whereby the influence of temperature and state of aggregation upon Raman spectra can be investigated at temperatures between + 50 and − 150° C, the temperature of the substance under investigation being kept constant to ± 0·2° C. The spectrograph is also protected against temperature variations. Some of the strong lines of the non-polar molecule benzene are studied and the change from liquid to solid is found to cause lowerings of the Raman frequencies varying from 0 to 2 ‰ in the different cases. As an example of a polar substance, HI is chosen and the maximum of the Raman band is found to be $\Delta\nu = 2165$ cm.$^{-1}$ for the liquid and about 2·5‰ lower for the solid. L. A. W.

2910. Normal Modes and Frequencies of Vibration of the Regular Plane Hexagon Model of the Benzene Molecule. E. B. Wilson, Jr. *Phys. Rev.* 45. *pp.* 706–714, *May* 15, 1934.—The thirty modes of vibration of the regular plane hexagon model for the benzene molecule, including both the hydrogen and carbon atoms, are derived by the group theory method described by Wigner. From these the twenty frequencies of vibration are calculated in terms of a simple potential function involving six force constants. Selection rules for the Raman and infra-red spectra are listed. Seven fundamentals are permitted in the Raman spectrum and four fundamentals in the infra-red. Both analytical and graphical descriptions of the modes of vibration are given. These depend largely on the symmetry of the molecule and are only in part influenced by the choice of potential function adopted. AUTHOR.

2911. Raman Effect of Conjugated Double Bonds in a Ring. R. Truchet and J. Chapron. *Comptes Rendus*, 198. *pp.* 1934–1936, *May* 28, 1934.—Results are given for the Raman spectra of cyclopentadiene and di-cyclopentadiene, isolated from the fractionation of crude benzene. The spectrum of cyclopentadiene contains no line in the region where the frequencies of C = C linkages are usually found, but shows instead a strong frequency at 1500 cm.$^{-1}$. Since the chemical properties of this substance indicate that the molecule contains conjugated double bonds, it is concluded that conjugation, although producing no change of the frequency of the double bonds in open chain compounds, causes a considerable decrease of the frequency in the case of a ring. It is pointed out that the fact that the benzene frequency 1580 cm.$^{-1}$, is lower than the ordinary ethylenic frequency cannot be taken as evidence that the benzene ring does not contain conjugated double bonds. L. A. W.

2912. Raman Effect and the Benzene Problem. J. Weiler. *Zeits. f. Physik*, 89. 1–2. *pp.* 58–62, May 15, 1934.—Examination and comparison of the infra-red and Raman spectra of benzene shows that this substance possesses only trigonal symmetry, viz., D_3, since two fundamental vibrations (ν_4 and ν_7) are active in both spectra. This is in accordance with Kohlrausch's hypothesis but contrary to the conclusions derived from X-ray and electron interference methods. It must be recognised, however, that the Raman spectrum is concerned with the outer valency electrons, and the other methods with the nucleus and inner electrons. H. F. G.

2913. Raman Spectra and Molecular Constants of the Hexafluorides of Sulphur, Selenium and Tellurium. D. M. Yost. C. C. Steffens and S. T. Gross. *J. Chem. Phys.* 2. *pp.* 311–316, *June*, 1934.—The Raman spectra of the gaseous and liquid hexafluorides of S, Se and Te were determined. Three lines for each substance were observed and this is the number permitted by the selection rules for a regular octahedral molecule. Frequency formulæ based on central forces were derived, and these, together with the appearance of the spectra, were used to assign the observed frequencies to the proper modes of vibration. Estimates of the magnitudes of the forbidden frequencies were made. A provisional value of $-$ 238,000 cal. is given for the free energy of formation of SF_6 (*g*) at 25°. AUTHORS.

2914. Raman Effect for Water in Different States. I. R. Rao. *Phil. Mag.* 17. *pp.* 1113–1133, *June*, 1934.—The shape and dimensions of the H_2O molecules are discussed and the vibration frequencies obtained from them correlated with the infra-red absorption frequencies. Results from Raman spectra of H_2O in different states are compared with the infra-red data. It is concluded that in the former there is only one band at about 3μ as against two at $2 \cdot 66$ and $6 \cdot 26\mu$ that are obtained in infra-red absorption. A comparison is made between the Raman frequencies of H_2O in different states. The changes could not be explained as due merely to change of state. They are explained as arising from new molecular aggregates formed, due to association of single into double and triple molecules with change from vapour to liquid and solid states. Other evidences for this theory of molecular association in H_2O are also discussed. AUTHOR.

2915. Modified Scattering by Crystalline HCl and HBr. D. Callihan and E. O. Salant. *J. Chem. Phys.* 2. *pp.* 317–319, *June*, 1934. —The values of the modified frequencies of radiation scattered by crystalline HCl and HBr at temperatures just below their freezing points are found to be 2784 cm.$^{-1}$ and 2480 cm.$^{-1}$, respectively, for the long wave edge. As with gases and liquids, the intensities of scattering are in the reverse order of intensities of absorption and the difference in the Raman shifts with change of state is too great to be attributed to Lorentz-Lorenz forces alone. The Raman band of crystalline HCl corresponds to the high frequency branch of two absorption bands found by Hettner, not to the centre of the bands ; on the possibility that, because of this correspondence, this branch is a *Q*-branch, the temperature variations of the

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absorption bands and the heat capacity at low temperatures can be accounted for. The non-existence of a third branch, for the *R*, is noted.
AUTHORS.

2916. Autocollimating Mirror Monochromator or Spectral Apparatus with Aperture F/4. C. Forch. *Zeits. f. Physik*, 89. 1–2. *pp.* 87-89, May 15, 1934.—An autocollimating spectral apparatus is described, the slit of which is at the focus of a concave mirror of aperture 50 mm. and focal length 200 mm. The light is reflected from the mirror at an angle of about 17° to the incident beam and is refracted at the surface of a 30° prism so as to fall normally on the back surface of the prism. The back surface of the prism is silvered and the light which has been refracted into a spectrum by the front surface of the prism is returned along its original path to form an image of the spectrum in the plane of the slit. The apparatus is very suitable for use as a monochromator. J. E. K.

2917. Broad Range Vacuum Spectrograph for the Extreme Ultra-Violet. K. T. Compton and J. C. Boyce. *Rev. Sci. Instruments*, 5. *pp.* 218–224, *June*, 1934.—A 2 m. focus, normal incidence, vacuum spectrograph is described which covers on one plate the whole range from the zero order up to the first order of λ2500. The 30,000 line per in. glass grating gives a dispersion of about 4·27 Å per mm. and strong spectra are obtained to wave-lengths as short as λ300, with lines a little below λ200 showing on long exposures. The body of the spectrograph is exhausted by an Aristovac pump to a pressure of 2×10^{-5} mm., a vacuum guard ring device of double rubber gaskets being used to seal the end covers. The instrument is particularly suitable for the establishment of short wave-length standards and for the study of line and band spectra from gas discharges and the study of absorption spectra in gases. The limitations of the instrument are discussed and suggestions are given, based on several years' experience with this instrument, for a spectrograph of new design which would avoid most of the difficulties inherent in this general type of vacuum spectrograph. AUTHORS.

2918. Quantitative Optical Spectral Analysis. W. Seith and E. Hofer. *Zeits. f. Elektrochem.* 40. *pp.* 313–322, *June*, 1934.—Tables are given for the quantitative optical determination of nickel in lead, lead in tin, and magnesium and calcium in lead by the homologous line pair method of Gerlach and Schweizer. Apparatus for use with solid electrodes and with solutions of salts of the metals is described. The method is not applicable to the determination of traces of cadmium in lead, lead in cadmium, or copper in lead, owing to the lack of suitable lines for comparison at low concentrations, and for these cases a method is described in which the degrees of darkening of a photographic plate caused by certain lines of the two components are compared photometrically. If the necessary precautions are taken the error is no greater than that of the homologous line pair method. H. F. G.

See also Abstracts 2682, 2690, 2691 2692, 2809, 2842, 2845, 2846, 2850, 2858, 2865, 2871, 2872, 2873, 2883, 2934, 2935, 2936, 2955.

VISION.

2919. Area and Brightness of Stimulus Related to the Pupillary Light Reflex. M. Luckiesh and F. K. Moss. *J.O.S.A.* 24. *pp.* 130–134, *May*, 1934.—Measurements of pupil diameter were made for a subject who fixated on the centre of a circular bright field in dark surroundings, the area and brightness of the field being varied in different experiments, keeping the illumination at the eye constant and equal to 10 ft.c. The mean results of eight subjects showed that the pupil area was a minimum for a field brightness of about 0·5 lambert and a field diameter of 17° visual angle. As the field brightness was increased to 13 lamberts or decreased to 0·04 lambert, the pupil area increased by between 20 and 30 %. An extended distribution of pupillo-motor reactors throughout the retina with maximum density within or near the macula is indicated by these results. Application of the data to lighting practice is discussed. W. S. S.

2920. Eye as Affected by Illumination. le G. H. Hardy. *Am. Illum. Eng. Soc., Trans.* 29. *pp.* 364–384, *May*, 1934.—A comprehensive treatise of the effect of light or visible radiation upon the eye, including its physical, pathological and physiological effects. The oculomotor functions are outlined, and the illumination requirements for each of these functions are discussed, as are also the psychological or perceptual functions of the eye, including its ability to perceive light, to perceive differences in light intensity and quality, to perceive objects or distinguish form, and to see quickly. A review of the gradual revision upward of the intensity levels described as most efficient is made, with comments pertaining to intensity, spectral quality, distribution, diffusion, and other variables as related to ease, comfort and efficiency of seeing. AUTHOR.

See also Abstract 2812.

X-RAYS.

2921. Discharge Rays. A. Dauvillier. *J. de Physique et le Radium*, 5. *p.* 184, *April*, 1934.—The author contends that the radiation observed by Reboul [see Abstract 2341 (1933)] is not to be interpreted, as the latter suggests, as the K- and L-radiation of light elements, but rather in terms of the phenomena observed by Wiedemann when sparks are produced in air in the neighbourhood of thermoluminescent substances covered with quartz or calcspar. [*Z. f. Elektrochem.* 2. *p.* 159, 1895.] J. S. G. T.

2922. Incoherent Scattering of X-Rays. F. Bloch. *Helv. Phys. Acta*, 7. 4. *pp.* 385–405, 1934. *In German.*—Heisenberg [see Abstract 1261 (1932)] has shown that calculations of the intensity of the incoherent scattered X-radiation based upon a method analogous to that used by Thomas and Fermi for the coherent X-ray scattering exhibit some divergencies from that observed experimentally. The author investigates these differences, following the Thomas-Fermi method of treating the extranuclear electrons as a degenerate gas but considering the zero-point energy of the gas as density fluctuations, the Fourier components of which produce the incoherent scattering. The existence of elastic waves in a degenerate Fermi gas is also discussed following Einstein's theory of Tyndall scattering. J. E. R. C.

2923. Scattering of X-Rays by Cold-Worked and by Annealed Beryllium. J. E. Boyd. *Phys. Rev.* 45. *pp.* 832–834, *June* 1, 1934.—The intensities of reflection of Mo $K\alpha$-radiation by important crystallographic planes in powdered beryllium have been measured by an ionisation method under the following conditions: (1) cold-worked particles of average diameter about $3 \times (10)^{-3}$ cm.; (2) the same after $\frac{1}{2}$ hr. at 800° C.; (3) cold-worked particles of average diameter about $(10)^{-2}$ cm.; (4) the same after 1 hr. at 950° C. In (2) and especially in (4) cold-working strains should have been relieved. The atomic structure factors derived from these data show no appreciable change with annealing and further show that Be crystals are rather imperfect. The mass absorption coefficient is found to be 0·26 in good agreement with a value computed according to Compton's empirical formula. AUTHOR.

2924. Densitometer for X-Ray Films. G. C. Henny. *Am. J. of Roentgenology & Radium Therapy*, 31. *pp.* 550–554, *April*, 1934.—Many densitometers for the determination of the density of X-ray films employ photoelectric cells, the current from which is amplified by valves. The latter introduces variation and the need of repeated calibrations. An instrument is described and illustrated, which employs a Weston photronic cell, operating without batteries or amplifier, thus overcoming the above objection. Details of construction and operation are given. B. J. L.

2925. Sensitivity of Photographic Films to X-Rays at Low Temperatures. G. E. M. Jauncey and H. W. Richardson. *J.O.S.A.* 24. *pp.* 125–126, *May*, 1934.—A microphotometric examination is made of the variation with temperature of the blackening of photographic film upon exposure to X-rays, temperatures as low as 103° K. being employed. Plotting the blackening against the time of exposure it is found that the experimental points fall upon a straight line passing through the origin so long as the density is not too great. Considering the whole density range, however, a slight curvature is observable. It is concluded (1) for a given temperature, the density is proportional to the time of exposure for densities not too great, (2) the slope of the straight portion of the density-time curve is a linear function of the temperature so long as the temperature is not too low. A. H.

2926. X-Ray Double-Refraction. H. Seemann. *Phys. Zeits.* 35. *pp.* 329–335, *April* 15, 1934.—An experimental paper, describing and figuring apparatus for measuring the above. A. D.

2927. Spectroscopy of Very Soft X-Rays. Part III. M. Siegbahn and T. Magnusson. *Zeits. f. Physik*, 88. 9–10. *pp.* 559–592, *May* 2, 1934.—The authors continue their previous work on the spectroscopy of long-wave X-rays (20 Å to 500 Å). [See Abstracts 3745 (1930) and 1201 (1934).] The M- and N-series are investigated, a concave grating being again employed. The spectra of 11 elements in the range Rb-Sn and of 16 in the range Cs-U are obtained. For Th an isolated line of the O-series is found. J. T.

2928. Quantum Theory of the Continuous X-Ray Spectrum. Part I. L. P. Smith. *Rev. Modern Physics*, 6. *pp.* 69–89, *April*, 1934.—The fundamental probability function for the continuous radiation spectrum is developed non-relativistically from Dirac's theory of radiation with the help of the treatment due to Sommerfeld and Scherzer. An orthogonal set of solutions is found for the wave equation of the hydrogen atom, to which the general equation for a system of atoms and electrons reduces as a special case, and the matrix elements are calculated. Fundamental transition probabilities are given, forming a basis for all intensity, polarisation, and electron scattering formulæ, and these, in turn, are developed. A mathematical Appendix gives a detailed derivation of the main relations employed. N. M. B.

2929. True Absorption Coefficients for Elements Au to Bi near the L-Absorption Edges. C. G. Patten. *Phys. Rev.* 45. *pp.* 662–666, *May* 15, 1934.—The L X-ray absorption spectra of the metals gold to bismuth were examined with a calcite crystal spectrometer and ionisation chamber. Thin films of Tl, Pb and Bi were evaporated on to very thin sheets of mica. The true absorption coefficients $\tau(L_{I})$, $\tau(L_{II})$, and τ (L_{III}) corresponding to the photoelectric absorption by the three types of L electrons were found to vary approximately as $\lambda^{2\cdot 56}$ for each of the five elements Au to Bi. With this relation the coefficients were computed for a given wave-length. Their ratio $\tau(L_{I}) : \tau(L_{II}) : \tau(L_{III})$ (which is therefore independent of the wave-length) was found to be constant over the range 0·5 to 1·5 Å and to have approximately the same value for each of the five elements. The value of the ratio was found to be 19 : 32 : 49. This ratio also gives the relative numbers of photoelectrons ejected from the three L shells by radiation of a given frequency. Ratios of $\tau(L_{I})$, $\tau(L_{II})$ and $\tau(L_{III})$ which are evaluated at their respective absorption edges L_{I}, L_{II} and L_{III} were also determined. This ratio of $\tau(L_{II})/\tau(L_{III})$ was found to be approximately 0·45 for each element and is in good agreement with the value predicted by relativistic theory. The ratio $\tau(L_{I})/[\tau(L_{II}) + \tau(L_{III})]$ has been found theoretically only by means of a nonrelativistic treatment of absorption. The experimental value, 0·163, is not in good agreement with the predicted value. AUTHOR.

2930. Diffraction of X-Rays in Glass. B. E. Warren. *Phys. Rev.* 45. *pp.* 657–661, *May* 15, 1934.—X-ray diffraction patterns of vitreous SiO_2 and GeO_2 have been made in an evacuated camera using Cu Kα radiation monochromatised by crystal reflection. Intensity curves are obtained from the microphotometer records in the usual way. A method is developed for calculating the scattering of X-rays in an amorphous solid and is applied to the diffraction patterns of glass. In vitreous SiO_2 each Si is tetrahedrally surrounded by 4 O atoms at a distance Si — O = 1·60 Å, and each O atom is shared between two such tetrahedral groups. The resulting network which is built up is random, it does not repeat at regular intervals, and is accordingly non-crystalline. From this picture of the glassy state, scattering curves are calculated for vitreous SiO_2 and GeO_2 which are in good agreement with experiment. AUTHOR.

2931. Electrometric Measurement of X-Ray Energy. N. Waterman and H. Limburg. *Phil. Mag.* 17. *pp.* 1144–1150, *June*, 1934.—The electrochemical effects of X-rays are to be distinguished in two different actions, viz., an "electrode effect" and a secondary process. The "electrode effect" depends quantitatively on the energy which is received by the chemical system, and may serve as the measure of this. A practical form of apparatus for this purpose is described. AUTHORS.

2932. Dynamic Theory of X-Ray Interference. Lotte Posener. *Ann. d. Physik*, 19. 8. *pp.* 849–877, *May*, 1934.—The dynamical theory of X-ray interference is discussed. On the assumption of a tensor dielectric constant the basic equation is deduced. In the case of one ray agreement is obtained with the usual crystal optics. The formulæ for the dispersion surfaces of two rays were then used to treat the reflection problem and to deduce the correction to Bragg's law. Thus the following result is got: With the previously given position of the mirror plane two ray planes perpendicular to each other give different values for the angle range of the total reflection and its middle point, or otherwise expressed, different values of Bragg's angle are obtained if the mirror plane is rotated on itself. J. J. S.

See also Abstracts 2713, 2968.

HEAT.

CALORIMETRY.

2933. Allotropy of Liquid Benzene. Specific Heat Data. E. Cohen and J. S. Buy. *K. Akad. Amsterdam, Proc.* 37. 5. *pp.* 278–280, 1934. *In German.*—Menzies and Lacoss [see Abstract 2288 (1932)] have pointed out that the rate of change with temperature of several physical properties of liquid benzene suffer a definite alteration at about 40° C. The present authors have examined the data obtained for the specific heat of liquid benzene by Mills and MacRae; Tréhin; Williams and Daniels; and Ferguson and Miller. In no case do they find the suggested kink in the specific heat-temperature curve, but they consider that an explanation should be sought for the differences which exist between the results obtained by these workers. R. W. P.

2934. Spectroscopic Calculation of the Molar Heats of Air, O_2, and N_2. M. Trautz and H. Ader. *Zeits. f. Physik*, 89. 1–2. *pp.* 1–11, May 15, 1934.—For N_2 the rotational and vibrational heat capacities are calculated; for O_2 only the vibrational heat capacity is calculated, since the rotational part reaches its final value of $2 \times \frac{1}{2}$ R below 28° Abs., which is the approximate limit for N_2. From the results, values are computed for the molar heat C_v of air at different temperatures between − 76 and + 1200° C. The calculated values are compared with those observed by various workers. L. A. W.

2935. Rotational Heat Capacity of Water Vapour. M. Trautz and H. Ader. *Zeits. f. Physik.* 89. 1–2. *pp.* 12–14, May 15, 1934.—On the basis of Mecke's recent analysis of the H_2O spectrum the rotational heat capacity of water vapour is calculated as a function of the temperature. It is found that the full value is attained a little above 50° Abs. L. A. W.

2936. Calculation of the Molar Heat of Cl_2 and the Atomic Heat of Cl. M. Trautz and H. Ader. *Zeits. f. Physik*, 89. 1–2. *pp.* 15–23, May 15, 1934.—The molar heat of Cl_2 is calculated from spectroscopic data as a function of the temperature, account being taken of the effect of isotopy. The rotational heat capacity reaches its full value below 1° Abs. The atomic heat of Cl is also computed. It is found that C_v passes through a maximum value of 3·4585 cal. at 579·41° Abs. and then falls to 3R/2 at higher temperatures. L. A. W.

2937. Specific Heats of Palladium. F. M. Jaeger and W. A. Veenstra. *K. Akad. Amsterdam, Proc.* 37. 5. *pp.* 280–283, 1934.—Improvements in the temperature measurements and the realisation that the metal requires annealing *in vacuo* before consistent results can be obtained have caused the accuracy of the earlier determinations of the specific heats of Pd to be doubted. The measurements have been repeated up to 1500° C., and it is now found that the mean specific heat at constant pressure is nearly a linear function of the temperature. It is represented by $c_p = 0\cdot058378 + 0\cdot60274 \times 10^{-5}t + 0\cdot860 \times 10^{-10}t^2$, and the true atomic heat is found to be $C_p = 6\cdot2288 + 0\cdot12862 \times 10^{-2}t + 0\cdot27528 \times 10^{-7}t^2$. R. W. P.

2938. Calorimetric Experiments on Thallium. W. H. Keesom and J. A. Kok. *K. Onnes Lab. Leiden, Comm. No.* 232*a*. *Physica,* I. *pp.* 595–608, *May,* 1934. *In English.*—The specific heats of thallium were measured with a magnetic field 0, while persistent currents were flowing. A second series of measurements was made while a magnetic field had been applied to the metal and the persistent currents arising from its application were flowing. These measurements provide a valuable confirmation of the hypothesis, that the transition of the supraconductive into the non-supraconductive state is a reversible process. Results are given of experiments concerning the cooling, brought about by adiabatic magnetic disturbance of supraconductivity. The specific heats of non-supraconductive thallium at very low temperatures were measured. The results show that at a definite temperature the difference $c_s - c_n$ changes sign, which is in accordance with Nernst's theorem, provided this can be applied here. [See Abstract 2548 (1934).] AUTHORS.

2939. Heat of Condensation by Direct Method. Part I. Liquids not Intensively Dried. A. Smits and D. Cannegieter. *Zeits. f. phys. Chem.* 168. *Abt.A.* 5–6. *pp.* 391–410, 1934.—The object of these researches is to ascertain if the heat of condensation is modified by intensive drying. A special calorimeter is used in which a constant temperature difference is automatically maintained between the calorimeter proper and a surrounding petroleum bath. So far experiments have only been made on normally dried liquids, the values obtained for benzene, bromine and ethyl bromide at 10°C. being 105·1, 46·74 and 60·51 cal./gm. respectively. R. W. P.

CONDUCTION.

2940. Heat Conduction and Eddy Motion in Two-Dimensional Circulating Fluids. W. Müller. *Ann. d. Physik,* 19. 8. *pp.* 809–828, *May,* 1934.—Diffusion phenomena are analysed for several cases of two-dimensional flow. These include flow about both linear and cylindrical heat sources and also the case where the sources are distributed on a cylindrical shell. By using the analogy between heat conduction and the spreading of eddies it is found possible to determine the velocity distribution within the eddy system. R. W. P.

See also Abstract 2976.

CONVECTION.

2941. Heat Transfer for Turbulent Flow in Pipes. H. Lorenz. *Zeits. f. techn. Physik,* 15. 4. *pp.* 155–162 *and* 15. 5. *pp.* 201–206, 1934.—The author has re-examined existing experimental results for the heat transfer between the walls of a surrounding tube and a turbulently flowing gas or liquid of low viscosity. It is shown that plotting the Nusselt number divided by the product of the Prandtl and Reynolds numbers against various other dimensionless groups presents a simple means of analysing the results. Additional information is thus obtained regarding the influence on the heat transfer of (i) the temperature drop between the walls and the fluid; (ii) the length of the pipe; and (iii) the condition of the internal surface of the pipe. R. W. P.

See also Abstract 2729.

DILATATION.

2942. Thermal Expansion of Soda-Lime-Silica Glasses. E. Seddon, W. E. S. Turner and F. Winks. *Soc. Glass Technol., J.* 18. *pp.* 5–13, *March,* 1934.—The thermal expansions, from room-temperature to the softening point, have been determined for a series of pure soda-lime-silica glasses ranging in composition from 70 to 80 % SiO_2, 2·7 to 14·4 % CaO, and 10·5 to 22·7 % Na_2O. The linear thermal expansion coefficients range from 658 to 1054 $\times 10^{-8}$, and the relationship between thermal expansion and composition is linear. The transformation and transition points were determined. AUTHORS.

2943. Transformation Points of Optical Glasses. E. Berger, M. Thomas and W. E. S. Turner. *Soc. Glass Technol., J.* 18. *pp.* 79–87, *March*, 1934.—The transformation temperatures of seven different optical glasses of very different composition and physical properties have been determined at Jena, at Berlin and at Sheffield, using in the first-named laboratory the thermal expansion method, and in the two others an electrical resistance method in different forms. The results are all in such good agreement as to indicate, in general, that the transformation point, when the glass is heated at a rate of approximately 4 ° per min., can be determined with an error not exceeding ± 5°. AUTHORS.

2944. Apparent Molal Expansibility of Electrolytes in Solution. F. T. Gucker, Jr. *Am. Chem. Soc., J.* 56. *pp.* 1017–1021, *May*, 1934.—The apparent molal expansibility of a solute in solution is defined by the equation $\Phi(E_2) = \alpha V - \alpha_1 V_1$, where α and α_1 are the coefficients of thermal expansion of the solvent and solution respectively, and V and V_1 the corresponding volumes per mole of solute. For seven electrolytes in water it is found that $\Phi(E_2)$ is a linear function of the square root of the volume concentration c. At 0° C. and 25° C. the graphs all have a negative slope, and the order of increasing slope shows similarities to the order for other apparent molal properties. The lower the temperature and the higher the valency type of the electrolyte, the greater is the slope and the more positive the limiting value of $\Phi(E_2)$ for $c = 0$. Equations are derived whereby the partial molal expansibilities of solute and solvent may be calculated from $\Phi(E_2)$. From the Debye-Hückel limiting law an expression is derived which predicts the linearity of $\Phi(E_2)$ with $\sqrt{c}$, but an estimate of the coefficient indicates that at 20° C. the slope should be positive instead of negative. L. A. W.

2945. X-Ray Examination of Copper-Zinc Alloys at High Temperatures. E. A. Owen and L. Pickup. *Roy. Soc., Proc.* 145. *pp.* 258–267, *June* 2, 1934.—A method is briefly described by which accurate values of crystal parameters are obtained from X-ray photographs taken when the material examined is maintained at high temperature *in vacuo*. The thermal expansions of the β-constituent in the $(\alpha + \beta)$, β and $(\beta + \gamma)$ regions of the Cu-Zn alloy system are found up to 600° C. The β-phase in the three regions was found to expand at the same rate up to the transformation temperature. The rate of expansion is slower above this temperature, but is again the same in each region. These change points noted in the expansion are shown distinctly, and are at about 450°, 470°, and 485° C. in the $(\alpha + \beta)$, β and $(\beta + \gamma)$ regions respectively, and correspond to the transformation temperatures recorded by previous workers by other methods. The explanation of the abrupt change found in the expansion curves is to be sought in the behaviour of the atoms within the lattice. The possibility of a change in orientation of the atoms *in situ* was considered improbable. It is concluded that the β-transformation is more likely to be due to a change in the distribution of the Cu and Zn atoms within the lattice. [See Abstract 2703 (1933).] AUTHORS.

See also Abstracts **2703**, **2704**.

MELTING AND BOILING POINTS.

2946. Freezing Points of Benzene Solutions. C. R. Bury and H. O. Jenkins. *Chem. Soc., J. pp.* 688–696, *May*, 1934.—The depression of the freezing point of benzene by 19 solutes has been determined by an equilibrium method to avoid the errors of the supercooling method and in particular those due to adsorption, since the concentration is determined after the solute has been adsorbed. CCl_4, chloroform, bromoform, *p*-dichlorobenzene, and ethylene dichloride are found to be ideal solutes. The freezing points of non-ideal solutions are discussed at length. In connection with internal pressure and deviations from the law of ideal solutions, the data obtained afford little support to Hildebrand's hypothesis, *e.g.*, CS_2 the dipole moment of which is zero, and the internal pressure of which is practically identical with that of benzene, should approximate most closely of all the solutes examined to an ideal solution ; it is, however, markedly abnormal. No correlation between internal pressure and activities could be detected. In connection with association and polarisation, agreement with theory is only satisfactory for certain non-associated substances, *e.g.*, CCl_4, *p*-dichlorobenzene, bromoform, and chloroform, and possibly also for quinoline, *o*-nitrophenol, and nitrobenzene. It would appear that the union of separate molecules by a chemical bond to form an associated molecule is a rare phenomenon, and that some loose association and orientation of neighbouring molecules seems more probable. H. H. Ho.

2947. Azeotropic Compositions for Benzene and Cyclohexane. A. Bouzat and M. Schmitt. *Comptes Rendus*, 198. *pp.* 1923–1925, *May* 28, 1934.—A method is described by means of which the constant boiling compositions of a mixture of two liquids can be determined. It is based on the comparison of the compositions of the condensed vapour with that of the original and residual solutions. The comparison is made by means of a differential Pulfrich refractometer. It is found best to use a liquid of definite composition and to vary the pressure until the azeotropic pressure for this composition is obtained. For a mixture of benzene and cyclohexane the proportion by weight of benzene in the azeotrope is 46·70, 48·64, 50·46, 52·01, 52·90, 53·65 for corresponding pressures of 9·30, 21·40, 41·01, 70·42, 94·52, 120·42 cm. of Hg. R. W. P.

2948. Liquefaction of He by an Adiabatic Method without Precooling with Liquid Hydrogen. P. Kapitza. *Nature*, 133. *pp.* 708–709, *May* 12, 1934.—The continuous liquefaction of He is effected by using a reciprocating expansion engine with a loosely fitting piston. The engine is housed in an evacuated enclosure containing heat exchange spirals and a container of liquid air for the preliminary cooling of the He. The He is compressed to 25–30 atmospheres and is allowed to escape freely through the gap between the piston and cylinder. The expanding stroke of the engine is made very rapid so that the escape of gas during this period is small and the efficiency of the machine is not appreciably effected. The final liquefaction is produced by making use of the Joule-Thomson effect. In 1 hr. 1 l. of liquid He is produced for the consumption of 3 l. of liquid air. R. W. P.

2949. Sublimed Iron. W. Kroll. *Zeits. f. Elektrochem.* 40. *pp.* 303–306, *June*, 1934.—The vapour pressure of solid iron is 0·001 mm. of mercury at 1267° C. Experiments show that it is possible to sublime iron in high vacua at between 1100°–1200° C. although it does not melt until 1533° C. F. J. W.

See also Abstracts 2678, 2729, 2939, 2950.

TEMPERATURE, MEASUREMENT OF.

2950. Solidification Point of Platinum. F. Hoffmann and C. Tingwaldt. *Phys. Zeits.* 35. *pp.* 434–436, *June* 1, 1934.—Experiments are described in detail for the exact determination of the platinum-point, utilising the gold-point as initial temperature. The experimental evaluation of the latter is also described by a method dependent upon black-body radiation. The value arrived at for the solidification-point of platinum is 1773·8° C. with an accuracy of ± 1°. H. H. Ho.

2951. Automatic Temperature Regulation for X-Ray Dark-Room Solutions. W. E. Chamberlain and G. C. Henny. *Radiology,* 22. *pp.* 539–547, *May,* 1934.—The importance of correct temperature of solutions for X-ray film development is generally discussed. Various arrangements are described for maintaining automatically the temperature of the solutions, by the use of solenoids actuating switches, to connect or disconnect hot or cold water supply. The schemes are based upon refrigerating engineering principles. B. J. L.

2952. Testing of Apparatus for Temperature Measurement and Meteorographs. W. Grundmann. *Zeits. f. Instrumentenk.* 54. *pp.* 191–198, *June,* 1934.—Various methods of testing temperature indicators are discussed, and a special arrangement for obtaining an isothermal bath at different temperatures from a mixture of spirit and solid CO_2 is described. In such an apparatus liquid, bi-metal thermometers and so forth are tested against resistance thermometers. For hair hygrometers and aneroid barometers, it is necessary to have a dry-testing chamber; this is described and results are given. H. M. B.

See also Abstracts **2813, 2905.**

THERMOCHEMISTRY.

2953. Calorimetric Determination of the Heats of Combustion of Ethane, Propane, *n*-Butane and *n*-Pentane. F. D. Rossini. *Bureau of Standards, J. of Research,* 12. *pp.* 735–750, *June,* 1934.—The calorimetric determination of the heats of combustion of ethane, propane, *n*-butane, and *n*-pentane was undertaken because of the dearth of information concerning these thermochemical constants for which there is pressing need in industry and in the sciences. The data of the present investigation give for the heats evolved in the combustion in oxygen, at a temperature of 25°C and a constant pressure of 1 atmosphere, of gaseous ethane, gaseous propane, gaseous *n*-butane, and gaseous *n*-pentane, respectively, to form gaseous CO_2 and liquid water, the following values, in international kilojoules per mole: Ethane, 1559·57 ± 0·44; propane, 2219·57 ± 0·51; *n*-butane, 2877·88 ± 0·63; *n*-pentane, 3536·00 ± 0·88. Converted to k-cal.$_{15}$ by means of the factor 1·00040/4·1850, these values become, in k-cal.$_{15}$ per mole: Ethane, 372·81 ± 0·11; propane, 530·57 ± 0·12; *n*-butane, 687·94 ± 0·15; *n*-pentane, 845·27 ± 0·21. The hitherto "best" values for the heats of combustion of these gases differ from the values obtained in the present investigation by the following amounts: Ethane, − 1·23 %; propane, − 0·87 %; *n*-butane, no data; *n*-pentane, − 0·86 %. These differences are from 30 to 50 times the estimated uncertainties in the values from the present investigation. AUTHOR.

2954. Compensation of the Electronic Energy and of the Energy of Repulsion in the Molecule of Hydrogen. J. Savard. *Comptes Rendus,* 198. *pp.* 1480–1482, *April* 23, 1934.—In a preceding note [see

Abstract 265 (1934)] the author has proposed the following postulate, *viz.*, that the energy of repulsion $\Delta(U)$ exerted between the ions of a molecule which have lost their $2n$ bonding electrons, is equal to the difference of the increases in the values of the ionisation potentials of the molecule and of the atoms according to the linear expression : $\Delta(U) = [\Sigma^{2n}I_m - 2nI_m] - [2\Sigma^{n}I_a - 2nI_a]$, where I_a and I_m are the experimental ionisation potentials of the atom and molecule respectively, $\Sigma^{2n}I_m$ is the work necessary to break the $2n$ bonding electrons of the molecule, and $\Sigma^{n}I_a$ is the work necessary for removing successively the n valency electrons of the atom. This postulate is now verified for the hydrogen molecule, where $\Delta(U)$ becomes $I'_m - I_m$, *i.e.*, the energy of repulsion between the two nuclei H^{-1} is equal to the difference of the ionisation potentials of the ion H_2^+ and of the molecule. The energy of repulsion deduced from the law of Coulomb is 19·65 volts and that derived from the above postulate is 19·62 volts. H. H. Ho.

2955. Heat of Dissociation of the Nitrogen Molecule. G. Herzberg and H. Sponer. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2. *pp.* 1–7, 1934.—A new value is calculated for the heat of dissociation of N_2 from the recent accurate determination of the triplet levels by the discovery of an intercombination system and from the observed predissociation limits in the triplet bands. The result, 169·3 k. cal., is considered to be more reliable than the values previously put forward. A short discussion is given of the term scheme of the N_2 molecule and the problem of active nitrogen. L. A. W.

2956. Speed of Flames and the Temperature Distribution in a Spherical Bomb from Time-Pressure Explosion Records. B. Lewis and G. v. Elbe. *J. Chem. Phys.* 2. *pp.* 283–290, *May*, 1934.—The velocity of flame relative to the mass movement of the gases in a closed spherical bomb is determined from an analysis of the time-pressure record of the explosion [see Abstract 1956 (1933)], and can be evaluated at any moment during its progress from the centre of the bomb outwards, as well as the temperature of the unburned phase, immediately behind the flame front, and the temperature gradient from the latter point to the centre of the bomb, and the pressure in the bomb at the same moment. Given a certain fraction burned of the total amount of gas, the volume of the products can be determined before and after expansion and when combustion is complete. Data and calculated flame speeds and temperatures are tabulated for mixtures of O_2 and O_3. The flame speed, and the pressure and temperature of the unburned gas increase from the centre outwards. A complete diagrammatic description is given for one explosion, and shows that the temperature gradient in the bomb does not affect the specific heat results obtained by the usual method of calculating the final temperature from the maximum pressure by means of the gas law. N. M. B.

See also Abstracts 2862, 2906, 2913.

THERMODYNAMICS.

2957. Transition Point of Liquid Helium. E. A. Guggenheim. *K. Akad. Amsterdam, Proc.* 37. 5. *pp.* 294–297, 1934.—The author refers to Keesom's discovery of the "transition-point" of liquid He and Ehrenfest's thermodynamical treatment of it [see Abstract 5377 (1933)]. Halpern tried to explain the "transition-point" on three suppositions,

(1) two possible phases each exist without any discontinuous properties, (2) only phase 1 is stable on one side of the transition-point and only phase 2 on the other, and (3) at the transition-point the two phases have equal values of Z, S, V and so also of E. The author shows that this hybrid transition-point is thermodynamically impossible and has arisen from a complete misinterpretation by Halpern of Ehrenfest's thermodynamics.
R. S. R.

2958. Molecular Magnitude and Phase Distribution. Part III. J. N. Brönsted and P. Colmant. *Zeits. f. phys. Chem.* 168. *Abt.A*, 5–6. *pp.* 381–390, 1934.—Expressions for the thermodynamic laws of solution are developed on the basis of the activity coefficients, and are applied to the case of isochemical substances of unequal molecular magnitudes. For the experimental work, *n*-butyl *n*-valerate and *n*-butyl sebacate were used as the isochemical substances. The activity coefficients were determined by measuring the vapour pressure of the volatile component in mixtures of these compounds with benzene or *n*-propyl bromide. In both sets of mixtures the coefficients are below unity, the components being held in the mixture by a certain chemical affinity. In agreement with the theoretical considerations the deviations from ideal solutions are much greater in the sebacate than in the valerate solutions. Moreover, in accord with the ratio 2 : 1 for the molecular magnitudes of the two isochemical components, the ratio between the logarithms of the activity coefficients of the two, log f_s : log f_v, is approximately 2 over the whole concentration range, and the same is the case for the volatile components. [See Abstract 159 (1932).]
T. H. P.

See also Abstracts 2714, 2732, 2942, 2943, 2945, 2960.

VAPOUR PRESSURE.

2959. Surface Vapour Pressure and Heat of Surface Vaporisation. J. Sameshima. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 155–158, *March,* 1934. *In English.*—The surface vapour pressure of myristic acid films on 0·02*N* HCl solutions at temperatures between 5° C. and 30° C. was deduced from surface pressure—molecular area curves obtained experimentally. The heat of surface vaporisation thence obtained was about one seventh of the three-dimensional heat of vaporisation of myristic acid at 200° C. From these two heats of vaporisation and the density of myristic acid at its melting point it is deduced that the radius of action of a molecule is 34 Å.
P. H. B.

2960. Vapour Pressure and Temperature above the Critical Point. M. Trautz and H. Ader. *Phys. Zeits.* 35. *pp.* 446–449, *June* 1, 1934.—A mass of CO_2 is maintained at constant volume under considerable pressure, and the variation of " vapour " pressure with temperature measured below and above the critical temperature. When the volume is the critical volume, a tangent drawn at the critical point, to the vapour pressure curve below that temperature, passes through all the observations at higher temperatures. If any other volume is chosen, the curve bends away from the straight line, after passing the critical temperature.
J. P. A.

See also Abstract 2949.

ACOUSTICS.

2961. Gongs. Part II. A. Pomp and B. Zapp. *Kaiser-Wilhelm Inst. f. Eisenforschung, Dusseldorf, Mitt.* 15. 3. *Abh.* 220, 1933. *Engineer,* 157. (*Metallurgist*), *pp.* 120–122, *April* 27, 1934.—Continuation of previous work [see Abstract 2120 (1934)]. The effect of tempering is studied, and for 0·63 carbon steel, 15 minutes at 300° C. gives maximum duration of the gong note. Increase of carbon content gave a shorter note in untempered gongs, and a longer note in those tempered at 300°. Beyond 0·63 % the carbon content had no further effect except in producing a fuller note. These results were verified by direct mechanical tests of the damping capacities of the steels. Parallel experiments were made on gongs the wires of which had been hardened by oil quenching from a temperature slightly above the A_3 point, and tempered at various temperatures. Rise in the tempering temperature produced progressive increase in length of note up to 500°. Above this point the duration diminished. G. E. A.

2962. Vibration of a Japanese Hanging-Bell. J. Obata and T. Tesima. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 211–214, *April,* 1934. *In English.*—The sound emitted by the bell was recorded by an oscillograph, using a condenser microphone and amplifier. The frequencies of vibration of the lower components were found to be in the ratio 2 : 5 : 7 : 9 : 11 . . . . The fundamental and second partial were observed to consist each of two vibrations, giving rise in each case to slow beats. J. E. R. C.

2963. Velocity of Sound. M. Kluge. *A.T.M.* 3. T61, *May,* 1934. —A survey of methods of measuring the velocity of sound in different media is given. The methods are grouped into (*a*) direct methods involving a measurement of the time taken for the sound wave to travel a specified distance, either by an oscillographic method or by Kunze's method (which makes use of the orientation effects which accompany binaural listening) and (*b*) indirect methods. J. E. R. C.

2964. Ultrasonic Waves. W. Rodewald. *Zeits. f. techn. Physik,* 15. 5. *pp.* 192–200, 1934.—This report includes sections on measurements of intensity and wave-length, reflection and scattering, absorption and velocity of propagation, the acoustical interferometer, optical phenomena, and chemical and biological effects. A comprehensive Bibliography is included. J. E. R. C.

2965. Stationary Ultrasonic Waves in Liquids. R. Wyss. *Helv. Phys. Acta,* 7. 4. *pp.* 406–412, 1934. *In German.*—The wave-length of stationary ultrasonic waves in various organic liquids is measured by an application of the Debye-Sears effect [see Abstract 4457 (1932)]. The temperature-coefficients of the velocity of ultrasonic waves in benzene and CCl_4 are also measured. The relative absorption of ultrasonic waves by different liquids is investigated, the maximum order of the spectra scattered from different sections of the stationary wave system being taken as a measure of the absorption. J. E. R. C.

2966. Oxidation Promoted by Ultrasonic Radiation. S. C. Liu and H. Wu. *Am. Chem. Soc., J.* 56. *pp.* 1005–1007, *May,* 1934. —An extension of previous observations [see Abstracts 2016 (1929) and 2641 (1932)] in which vibrations of frequency $1{\cdot}4 \times 10^6$ were used. O_2 and cavitation are both essential for ultrasonic oxidation. The

O_2 is directly activated by the radiation, and only the O_2 molecules on the surface of the bubbles are active during radiation. The active O can liberate I from KI, or react with water to form H_2O_2. When CCl_4 or $CHCl_3$ is present it reacts with the active O to give free Cl_2. G. E. A.

2967. Virucidal Action of H.F. Sound Radiation. W. N. Takahashi and R. J. Christensen. *Science,* 79. *pp.* 415–416, *May* 4, 1934.—The virus of typical tobacco mosaic was extracted from the infected leaves and exposed to sound vibrations of frequency 450,000. The results obtained indicate that the tobacco mosaic virus is inactivated by the radiation. Inactivation is found to be progressive with time of exposure, and after 2 hr. exposure the presence of active virus could not be detected by inoculating leaves of N. glutinosa. J. E. R.

2968. X-Ray Study of Voiced Consonants. G. O. Russell. *Acoustical Soc. of America, J.* 5. *pp.* 247–251, *April,* 1934.—A study of the interior of the mouth by means of X-ray photographs, when the consonant *z* is being spoken. A short exposure (1/128 sec.) is made to catch the consonant as it occurs in normal speech, and examination of the photographs brings out that the position of the tongue, its point of contact, and other details of the tongue and mouth cavity all vary when the vowels on either side of the *z* are changed. The only manifestation which remains fairly constant is the diameter of the aperture between the tongue and the alveolar ridge. G. E. A.

2969. Acoustical Frequency Analysis. M. Kluge. *A.T.M.* 3. T46–47, *April,* 1934.—The author gives a critical survey of methods of analysing sounds. The methods are divided into those using (1) oscillographs, (2) acoustical and electrical resonators, (3) search tones and (4) band-pass filters, the two latter groups receiving most attention. As regards search tone analysis the following methods are noted as having been used to combine the search tone with the sound to be analysed (*a*) the use of a dynamometer or string electrometer, (*b*) the use of a triode or crystal rectifier and (*c*) the use of a special hexode valve. It is noted that, as normally used, an increase in the resolving power of the analyser is accompanied by an increase in the time taken to make the analysis, but that this difficulty can be overcome by taking a sound-film record of the sound and analysing the record afterwards. J. E. R. C.

2970. Comparison of Acoustical Impedances. K. Schuster. *Phys. Zeits.* 35. *pp.* 408–409, *May* 15, 1934.—A pure tone enters a tube at its middle, and is propagated equally in either direction only if the corresponding impedances are equal. The symmetrical propagation is tested from a side tube which joins two apertures symmetrically placed in the tube. When a minimum of intensity is observed in a listening-tube suitably situated, the impedances in the main tube are equal. An arrangement is made to vary continuously one impedance, so as to balance an unknown impedance at the other end of the tube. J. P. A.

2971. Strobophotography in Bird Singing. M. Metfessel. *Science,* 79. *pp.* 412–413, *May* 4, 1934.—The notation of bird songs is obtained by the strobophotograph, which automatically plots a graph showing vertically the pitch, in which 1 cm. represents a half-tone of the equal-tempered scale, and horizontally time, in which 50 cm. represent 1 sec. The trills of birds are found to be very rapid, quite outside human duplication ; noise is generally interspersed with tones and very often a burring between a human whistle and hum is present. H. M. B.

See also Abstracts 2738, 2815, 3059.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

2972. Theorem of Electrical Networks with an Application to Filters. B. van der Pol. *Physica*, 1. *pp.* 521–530, *May*, 1934. *In English.*—A new general theorem on electrical networks is given. The proof of this theorem is given with the aid of the recent development of the symbolic calculus. The theorem is applied to an ordinary L*Cr* circuit. A further application of the theorem is given to filters. If the " indicial admittance " of the low-pass filter is given, the theorem enables the " indicial admittance " of a high-pass filter to be written down in a new form, being an integral containing two Bessel functions. The theorem is *mutatis mutandis* also applicable to mechanical systems. AUTHOR.

CONDUCTION AND DISCHARGE IN GASES.

2973. Theory of Corona Discharge. J. H. Bruce. *Phys. Zeits* **35** *pp.* **412–413**, *May* **15, 1934.**—Deutsch has recently given a theory of the density distribution in a gas discharge [see Abstract 3729 (1933)]. In the present paper the theory is further developed and the problem of the discharge between parallel conductors of any shape is shown to depend on the solution of a linear integral equation. A. W.

2974. High-Current Glow Discharge at Atmospheric Pressure. H. Thoma and L. Heer. *Zeits. f. techn. Physik*, **15**. 5. *p.* 186, 1934.—Further experiments on the conditions of change-over from a glow discharge at atmospheric pressure to a lower-voltage type of discharge are described. Using a U-shaped copper tube of 6 mm. external dia. and walls 1 mm. thick for one electrode, with water cooling, glow discharges up to about 0·9 ampere could be obtained. With some slight modifications to the apparatus and an increased water pressure the limit of the change to the low voltage discharge was increased to about 1·1 A. Brass and aluminium electrodes both give lower values for the current at which the change-over occurs, but a copper-plated brass electrode gave the same value as a solid copper electrode. Using tungsten disc electrodes of 15 mm. dia., 2 mm. thick, carefully polished and about 0·5 mm. apart, glow discharges with currents of as much as 5·6 A. were obtained. [See Abstract 5396 (1933).] A. W.

2975. Separation of Temperature and Field Excitation in the Electric Arc. H. Witte. *Zeits. f. Physik*, **88**. 7–8. *pp.* 415–435, *April* **21, 1934.**—When the arc voltage is abruptly reduced to zero by means of an interrupter, any electrons excited by the field to energies greater than those corresponding to temperature equilibrium with the arc gas, lose their excess energy in a time of the order of 10^{-5} sec. Thus light emission due to field excitation ceases in about 10^{-5} sec., whereas emission by temperature excitation follows the cooling of the arc gas, and decrease in such emission becomes appreciable only after a time of the order of 10^{-3} sec. Working with a CdO or ZnO cored carbon arc and measuring the decay in light emission for the spectral lines of the core metal (Cd or Zn), the author established that light emission was by pure temperature excitation save just before the kathode where field excitation contributed a part.

When the arc was restruck (2×10^{-8} sec. after being extinguished) field excitation predominated temporarily until the normal temperature excitation took charge. W. S. S.

2976. Accommodation Coefficient and Fraction of Current Carried by Ions in a L.V. Arc. I. A. Getting. *Phys. Rev.* 45. *pp.* 788–793, *June* 1, 1934.—The upper limit for the value of the fraction of the current at the kathode of a l.v. arc carried by positive ions is estimated to be less than 0·5. A method is derived for experimentally determining this fraction from pressure measurements made within the arc plasma. A vane was inserted into the plasma of a helium arc and the force on it was measured with a sensitive torsion balance. A procedure is developed for correcting for radiometric forces and for changing surface conditions. The fraction mentioned above is determined as a function of total arc current. This fraction increased with increasing arc current, but never exceeded 0·2 as long as the arc remained a true arc. These experiments demonstrate the enormous velocities of the neutralised positive ions coming from the kathode, and show the sensitivity of the accommodation coefficient to changes in surface conditions. AUTHOR.

2977. Current Transfer in the Mercury L.V. Arc. F. Lüdi. *Phys. Zeits.* 35. *pp.* 373–376, *May* 1, 1934.—Lüdi objects to the view put forward by Gehrts [see Abstract 758 (1934)] that the electron emission at the kathode is principally determined by Schottky effect, on the ground that the available surface field is insufficient. **Gehrts,** in replying, points out that owing to the close proximity of the plane of zero net force (image force + external surface field) to the actual surface (a distance of the order of 10^{-7} cm.) the surface structure may account for an error of × 10 in the calculation of the surface field. Several other points are discussed. W. S. S.

2978. Effect of a Stream of Slow Electrons on the Plasma of a Mercury Vapour Arc. S. Gvosdover and F. Konovalov. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1. 9. *pp.* 553–557, 1934. *In German.*—The parts of a gas discharge in which the space charges are compensated are now generally referred to under the term plasma. A spherical discharge tube of about 12 cm. dia. was fitted with an incandescent tungsten kathode, a molybdenum anode and two probes, and contained a drop of Hg. One probe consisted of an equipotential incandescent oxide-kathode with independent heating, while the control probe was a molybdenum disc, 2 cm. dia. The discharge tube was maintained in connection with a pump during observations. With a suitable potential between the anode and the oxide-probe, a potential lower than the ionisation potential, a stream of slow electrons is emitted from the probe, but these electrons cannot ionise by direct impact the unexcited Hg atoms. The condition of the plasma is therefore determined principally by the discharge ratios between the tungsten kathode and the anode. But for the production of the current between the oxide-probe and the anode the plasma generated by the current between tungsten kathode and anode must change its stationary state, and the temperature distribution of the electrons must alter correspondingly. These conclusions were established experimentally. A. W.

2979. Mechanism of the Positive Column of the Glow Discharge in Argon. O. Groos. *Zeits. f. Physik,* 88. 11–12. *pp.* 741–756, *May* 5, 1934.—Measurements were made of the longitudinal field, the carrier density, the wall current and the electron temperature in the positive column of a hot-kathode discharge in carefully purified argon at various pressures. The results obtained confirm those of Seeliger for the region of higher pressures. In the region of lower pressures, which has not previously been investigated, a second minimum of the gradient was found. An explanation of the complex dependence of the gradient on the free path is given, which is in good agreement with the experimental results. The observed wall currents for the different pressure zones (long, medium and short free paths) are in good agreement with the values calculated from Langmuir's plasma theory. A. W.

2980. Measurement of Concentration of Carriers in Glow Discharges. E. F. Buchmann. *Zeits. f. techn. Physik*, 15. 5. *pp.* 180–186, 1934.—Investigation of the possible sources of error shows that the concentration of the carriers in glow discharges cannot be measured with the accuracy which hitherto in the literature of the subject appears to have been assumed. In measurements of the electron concentration the results are found to have an uncertainty factor of ± 1·5 to ± ·18. For the positively charged carriers, on account of insufficient knowledge of the temperature, the uncertainty is considerably greater and uncertainty factors of ± 5 to ± 10 may quite possibly occur. It is also shown that the field of the probe is not completely screened by the surrounding space-charge layer and under certain conditions may produce an appreciable effect at a considerable distance from the probe. A. W.

2981. Excitation of Ne by Electron Impact. J. E. Taylor, R. Whiddington and E. G. Woodroofe. *Leeds Philosoph. & Lit. Soc., Proc.* 2. *pp.* 534–535, *May*, 1934.—A continuation of an earlier research in which the excitations of a number of levels in the He spectrum were observed by measurements of the magnetic spectrum of a beam of low voltage (120 volts) electrons, after passing through the gas. In Ne the observed energy losses were 16·76 ± 0·02, 19·98 ± 0·04, and 18·63 ± 0·04 volts with relative probabilities of 16, 5 and 4 respectively. The 16·76 volt loss corresponds to the excitation of the $^1P_1$ level, which gives the well-known 736 Å ultra-violet line; the other excitations cannot be designated with certainty. J. E. R.

2982. Excitation of N_2 by Electron Impact. J. E. Roberts. *Leeds Philosoph. & Lit. Soc., Proc.* 2. *pp.* 536–543, *May*, 1934.—A brief survey is made of the question of the excitation of diatomic molecules by electrons, from the normal to higher electronic states, and two problems arise—(*a*) the most probable energy loss of the exciting electron, and (*b*) the probability of excitation of vibrational levels near to the most probable level. The case of the $X \rightarrow a$ transition in N_2 is considered in detail. The best available potential energy curves are obtained, using the known spectroscopic data and the Morse formula. Assuming harmonic vibration of the nuclei, the relative probabilities of excitation of a few of the vibration levels of the " a " state are calculated. These are found to be in good agreement with the experimental results of Brindley, though the most probable energy loss found by Rudberg is somewhat higher. J. E. R.

2983. Fock-Dirac Atom Model and the Existence of Ionisation Potentials. L. Brillouin. *J. de Physique et le Radium*, 5. *pp.* 185–192, *May*, 1934.—The exchange effects involved in the Fock-Dirac atom are discussed in analogy with the known problems of the Fermi-Thomas atom. The exchange term plays an important part in the evaluation of ionisation potentials, for which the Fermi atom gives too low a value in a many-electron system such as a metal. The conditions under which a correction, based on wave mechanics, can be applied to this value in the case of atoms and metals or to the theory of the nucleus are discussed. N. M. B.

2984. Behaviour of Electrons in Nitric Oxide. V. A. Bailey and J. M. Somerville. *Phil. Mag.* 17. *pp.* 1169–1176, *June*, 1934.—With the same method [see Abstract 1160 (1933)], H_0 denoting the megnetic force ‖ to Z causing the electronic stream to spread exactly as a stream of ions in Z, *k* the ratio of the mean energy of an electron to that of a molecule at 15°, W the drift velocity of the electrons, and the other symbols having their previous meanings, H_0/Z, *k*, and W for NO are plotted against Z/p, and L and λ against *u*. L decreases as *u* increases from $2 \cdot 8$ to 5×10^7 and is then nearly constant to $u = 8 \times 10^7$ cm./sec.; *h* also diminishes as *u* increases. NO thus resembles O_2 in conformity with the generalisation that an electron is more likely to remain attached the further it penetrates into the molecule. L and *h* appear to diminish as *u* increases in paramagnetic, to increase in diamagnetic gases. The peak of the λ/u curve corresponds to the first harmonic ($2 \cdot 6\mu$) vibration absorption band in the infra-red, and not to the fundamental band ($5 \cdot 3\mu$). [See Abstract 4090 (1930).] C. A. S.

2985. High-Intensity Mass-Spectrometer. W. R. Smythe, L. H. Rumbaugh and S. S. West. *Phys. Rev.* 45. *pp.* 724–727, *May* 15, 1934.—A mass-spectrometer has been constructed in which is used a new type of magnetic lens capable of focussing on a slit all the positive ions of a given mass from an extended source. Electrostatic focussing permits 12 % or more of the ions from an area of 30 sq. cm. to be brought into a nearly plane beam and focussed by the lens. Practically complete separation of the potassium isotopes has been accomplished with an ion current of $0 \cdot 1$ mA for K^{39}, which deposits 1 mg. in 7 hr. Samples of Li^6 and Li^7 have been collected. AUTHORS.

2986. Field Combinations for Velocity and Mass Spectrography. Part II. W. Henneberg. *Ann. d. Physik*, 20. 1. *pp.* 1–12, *May*, 1934.—The field in the equatorial plane of a magnetic dipole is investigated under the following two conditions in order to determine whether it is suitable for the velocity or mass separation of charged particles: (*a*) when an electron lens is also employed; (*b*) when used in conjunction with a homogeneous magnetic field and the electric field of a cylindrical condenser. [For Part I, see Abstract 1679 (1934).] J. E. K.

2987. Magnetic Objective for the Electron Microscope. E. Ruska. *Zeits. f. Physik*, 89. 1–2. *pp.* 90–128, *May* 15, 1934.—In order to investigate arbitrary objects by means of an electron microscope it is necessary to prepare them in the form of thin films which can be permeated by means of fast electrons, and to obtain as great a magnification of such objects as possible further improvements are made in the design of a magnetic coil as an electron objective for fast kathode rays. The results of measurements of the most important relations between the effective diameter of the coil, the number of ampere-turns and the focal length are given as well as data concerning the least attainable focal length, the positions of the principal planes and the aberration of the lens. J. E. K.

2988. Device for Showing Direction of Motion of Oscilloscope Spot. E. R. Mann. *Rev. Sci. Instruments.* 5. *pp.* 214–215, *June*, 1934.—A circuit is described which has for its purpose the determination of the direction of rotation of the fluorescent spot obtained in current-voltage oscillograms. The figure described by the rotating spot is interrupted at a suitable point in the cycle by means of a neon lamp discharge, and examination of this interrupted figure readily leads to the correct conclusion as to the direction of rotation which prevailed in the original figure. AUTHOR.

2989. Wilson Apparatus for Variable Pressures. F. Joliot. *J. de Physique et le Radium*, 5. *pp.* 216–218, *May*, 1934.—The release of the piston in the operating chamber, in which the pressure when the fog tracks are observed can be reduced to 1 cm. Hg, is effected by a second piston working at atmospheric pressure. Metallic elastic joints are used, dispensing with the use of rubber, and so diminishing friction. The working interval at the lowest pressure is about 1/8th of that at atmospheric, but the fog tracks then persist longer, to a maximum of 5 sec. At pressures < 20 cm. Hg electrons of low energy ($< 40{,}000$ e.V.) give no tracks, while strongly ionising, *e.g.*, α-particles continue to do so. Detailed diagrams are given. C. A. S.

See also Abstracts 2749, 2833, 2834, 2860, 2886, 2954.

CONDUCTION IN SOLIDS AND LIQUIDS.

2990. Theory of Metals. R. Peierls. *Zeits. f. Physik*, 88. 11–12. *pp.* 786–799, *May* 5, 1934.—Replying to the criticisms raised by Kretschmann against the Bloch theory [see Abstract 1687 (1934)] the author shows that one criterion for the applicability of the theory is in the main confirmed although the formula must be modified in the region of the limit. This does not however affect the important results involving the relation between conductivity and temperature. Another objection to the usual theory is disproved. In reply **E. Kretschmann** maintains that the principal objection to the Bloch theory still exists (the non-fulfilment of the resonance conditions) and explains the apparent contradiction between the acceleration of the centre of gravity of an electron following the impulse jump and the acceleration of the groups found by Bloch. R. L.

2991. Electron Theory of Metals. S. Schubin and S. Wonsowsky. *Roy. Soc., Proc.* 145. *pp.* 159–180, *June* 2, 1934.—The most serious difficulty in the current theory of metals is that the models used do not allow of the simultaneous treatment of electric and magnetic properties, *e.g.*, conductivity and ferromagnetism. For example in Heisenberg's model which can be applied with some success to ferromagnetism, the approximation on which the theory is constructed considers only *non-polar* states of the constituent atoms, and therefore no one of the states of the model can carry any current. The necessary generalisation is attempted in this paper by including in the zero approximation of Heisenberg's model also *polar* states in which some of the atoms have two electrons and others none. The inclusion of these states allows for travelling electrons and therefore for states carrying current and also modifies in an important way the conditions for a ferromagnetic. These conditions prove to be much more restrictive than appears in Heisenberg's theory and ferromagnetics should be rarer than that theory leads one to expect—in conformity with the facts. The conditions for a ferromagnetic which replace the simple $J > 0$ of Heisenberg's theory are formally set out here and appear to explain why the alkalies cannot be ferromagnetics even if they have a positive J. AUTHORS.

2992. Electronic Energy Bands in Metals. J. C. Slater. *Phys. Rev.* 45. *pp.* 794–801, *June* 1, 1934.—The method of Wigner and Seitz [see Abstract 2673 (1933)] is extended to the computation of the excited bands of electrons in a metal, with particular applications to sodium. Instead of using simply one *s* wave function, as Wigner and Seitz do, a combination of eight separate functions is used, one *s*, three *p*, three *d*, and one *f*. Boundary conditions for an arbitrary electron momentum are satisfied at the mid-points of the lines connecting an atom with its eight nearest neighbours. The solution is carried out for an arbitrary direction of propagation in one of the principal planes. Energy levels and wave functions are determined as functions of internuclear distance, leading to the following qualitative results: at the observed distance of separation, energy levels are given with remarkable accuracy by the Fermi-Sommerfeld theory, the gaps fall approximately where they should as computed from de Broglie waves, and the wave functions act accurately like plane waves in the region between atoms, but fluctuate violently, like $s, p, \cdots$ functions, near the nuclei. Gaps in energy are precisely filled up, though in each definite direction of propagation there are gaps. As the internuclear distance increases, gaps in energy appear at definite points, the allowed regions shrinking to zero breadth about the atomic energy levels at infinite separation. AUTHOR.

2993. Simple Constant-Level Suspension. R. P. Johnson and W. B. Nottingham. *Rev. Sci. Instruments*, 5. *pp*. 191–192, *May*, 1934.—A suspension is described which effectively keeps an instrument at a constant level and protects it from small vibrations. It consists of a rigid cage hanging from a frame by a piece of steel piano wire; small rubber bands stretched horizontally from the corners of the frame to the bottom of the cage damp out rotation. T. I. J.

2994. Control Apparatus for a Double-String Einthoven Galvanometer. W. H. H. Gibson. *Journ. Sci. Instruments*, 11. *pp*. 187–193, *June*, 1934.—The apparatus described has been developed for the purpose of increasing the utility of a double-string Einthoven galvanometer for general laboratory use. It contains all switchgear required for the calibration and the use of the galvanometer, as well as for various auxiliary apparatus, such as the time-marker and a remote-control camera release. The switches for the galvanometer circuits are interlocked to protect the instrument from damage through errors in manipulation, and thus also to permit more rapid handling. AUTHOR.

2995. Absolute Determination of the Ampere. H. L. and R. W. Curtis. *Bureau of Standards, J. of Research*, 12. *pp*. 665–734, *June*, 1934.—The current balance originally used by Rosa, Dorsey, and Miller [see Abstract 74 (1912)] has been somewhat modified and used to determine the absolute value of the ampere. The value in absolute amperes of the current in the coils of the balance was determined from the measured constants of the coils and the electromagnetic force between them. The most important constant which could be directly measured was the ratio of the radii of the coils, which was measured by an electrical method. The values obtained on four sets of coils indicated that there was no error in the measurement of the ratio of the radii greater than three parts in a million. The current through the balance was measured not only in absolute units, but also in terms of the international units of e.m.f. and resistance as maintained at the Bureau of Standards. The final result of measurements with four different coil combinations was

1 B.S. International Ampere = 0·999928 Absolute Ampere.

The authors estimate that this result differs from the true value by less than 20 parts in a million. This result agrees within experimental error with that obtained in 1911, indicating that the unit of current as realised at the Bureau of Standards by standard cells and standard resistances has not changed appreciably since then. AUTHORS.

2996. Sensitivity of the Wheatstone Bridge. J. Fischer. *Zeits. f. Instrumentenk.* 54. *pp.* 137–155, *May,* 1934.—The variations of p.d. between the detector points in the absence of the detector, of detector current, and of the power absorbed by the detector, are calculated with respect to variation of the unknown resistance for each of the five cases obtained by assigning constant values in turn to the p.d. applied to the bridge, the current supplied to it, the power absorbed by it, the maximum permissible load of the resistance under measurement, and the e.m.f. and resistance of the battery. The expressions yield the optimum relations between the resistances of the network and curves showing variation of sensitivity with variations of the ratios of the resistances. P. V.

2997. Variations of Resistance of a Metallic Conductor of Small Volume. J. Bernamont. *Comptes Rendus,* 198. *pp.* 1755–1758, *May* 14, 1934.—When a current is passed through, *e.g.*, an electrodeposited film, the resistance of the film undergoes variations proportional to the square of the current. Theoretical considerations show that, assuming the effect is a result of the corpuscular theory of electricity, it can be explained only on the theory of free electrons. H. F. G.

2998. Resistance of Platinum at Low Temperatures. W. J. de Haas and J. de Boer. *K. Onnes Lab. Leiden, Comm. No.* 231*c. Physica,* 1. *pp.* 609–616, *May,* 1934. *In English.*—The resistance of very pure platinum has been investigated at very low temperatures. As a result it is found impossible to represent the experimental data by a simple formula, nor does the more complicated formula of Vonsovsky and Smirnov $(R/R_{0^\circ C.} = C_1T^5 + C_2T^4 + C_3T^3)$ [see Abstract 1689 (1934)] agree with the results. AUTHORS.

2999. Effect of Gas on the Unilateral Conductivity of Carborundum Detectors. (Miss) M. Quintin. *Comptes Rendus,* 198. *pp.* 1677–1679, *May* 7, 1934.—Experiments were carried out on SiC detectors contained in a vessel which could be evacuated or filled with different gases. The resulting curves are rather complex, but show that, within certain limits of gas pressure, the dissymmetry of the two branches of the characteristic is increased by prolonged evacuation, by lowering of the pressure, or by heating the contact; *i.e.*, by diminution of the adsorbed gases. The effect of the nature of the gas is less marked. Argon has a greater effect on the dissymmetry than helium, but this is probably due to the fact that prior to the tests with argon the apparatus had been subjected to prolonged evacuation. The results are briefly discussed. [See also Abstract 1278 (1934).] A. W.

3000. Explanation of Supraconductivity. J. Frenkel. *Nature,* 133. *pp.* 730–731, *May* 12, 1934.—Advances an explanation of supraconductivity based on the supposition that the dielectric consant ϵ of the substance is infinite while its conductivity remains finite or may even become zero, instead of the more usual method of assuming the specific electric conductivity σ to be infinite. The meaning of this new definition is made clear by examining the mechanism of ordinary electric conduction (σ finite) and ordinary polarisation (ϵ finite). This new theory is in accordance with the recent discovery of Meissner that the magnetic permeability of a metal in the supraconducting state drops to zero. A more complete account of the theory will be published later. R. L.

3001. Conductivity of Thin Metallic Films in an Electrostatic Field. E. Perucca. *Accad. Sci. Torino, Atti.* 69. 1. *Disp.* 2. *pp.* 166–170, 1934.—Metallic films of Au and of Pt deposited on quartz, having a resistance comprised between $\sim 10^{12}$ and $\sim 10^{10}$ ohms, have shown a conductivity strongly variable in a reversible manner with the electro-static charge. The effect consists always in an increase of the conductivity by the action of the external field, whatever may be the sign of the charge. Increases of conductivity up to 40 % have been observed. J. J. S.

3002. Electrolytic Conductivity of Alkaline Earth Chlorides in Water at 25° C. T. Shedlovsky and A. S. Brown. *Am. Chem. Soc., J.* 56. *pp.* 1066–1071, *May,* 1934.—The conductivities of solutions of alkaline earth chlorides in water were measured at 25° C. over a range of concentrations of 10^{-4} to $0 \cdot 1$ *N.* The measurements confirmed the Onsager limiting conductance equation. A convenient form of quartz pyknometer is described, and results of measurements of density of aqueous solutions of alkaline earth chlorides at 25° C. are recorded. F. J. B.

See also Abstracts 2703, 2938, 3017, 3033, 3063, 3067.

DIELECTRICS AND CAPACITANCE.

3003. Dielectric Constants of Chemical Compounds. F. Keller and W. R. Lehmann. *Zeits. f. Physik,* 88. 9–10. *pp.* 677–682, *May* 2, 1934.—The dielectric constants of compounds of Sr, Tl, Pb, K, Na, Hg, Mg, Sn, Ta, U, Zr, Ti and W have been determined by the mixed method, and by a plate method in which the salt in powdered form is placed between plates, and pressures up to 10,000 atmospheres applied. The plate method gives lower values of dielectric constant than the mixed method, and it is concluded that pressures greater than 10000 atmospheres are required. Drying the salts by heating and treatment with drying agents in general decreases the dielectric constant. [See Abstract 2940 (1932).] E. R.

3004. Dielectric Constant of Nitrogen up to 1000 Atmospheres between 25° and 150° C. A. Michels, A. Jaspers and P. Sanders. *Physica,* 1. *pp.* 627–633, *May,* 1934. *In English.*—The dielectric constant of N^2 is measured from 1–1000 atmospheres and 25°–150°. Results do not show a variation of the Clausius Mossotti relation $P = [\epsilon - 1/\epsilon + 2]\, 1/d =$ constant, within the experimental accuracy. AUTHORS.

3005. Influence of Dipole Fields between Solute Molecules. Parts I and II. R. M. Fuoss. *Am. Chem. Soc., J.* 56. *pp.* 1027–1033, *May,* 1934.—Part I deals with osmotic properties which are derived for a dilute solution of dipole molecules using an ellipsoidal model to represent the solute particles. An explicit asymptotic expansion, valid for the case of large moments and solvents of low dielectric constant, is calculated to a first approximation and corresponds to electrolytic solutions in such solvents. Part II considers molecular polarisation, and a calculation is given of the limiting law for this quantity for a dilute dipole solution, using the same model and assumptions as in Part I. The further restriction is made that the field strength used in measuring the dielectric constant is weak, and that the period of the impressed field is large compared with the time of relaxation of a dipole molecule. As in Part I, the case studied corresponds to electrolytic solutions in such solvents. H. H. Ho.

3006. Dipole Moments of Liquids. F. R. Goss. *Chem. Soc., J.* *pp.* 696–699, *May,* 1934.—An investigation of the effect of the liquid state on the dipole moments of molecules [see Abstract 5031 (1933)] has made it evident that the several values which are obtained for any given compound fall into a regular order, which depends in the first place on the dielectric constant of the medium surrounding the substance under observation. In this paper, the connection between the polarisation constants of polar molecules and dielectric constants is considered from the standpoint of Raman and Krishnan's theory of electrical and optical properties which gives an exact explanation of the variation of polarisation and dielectric constant for a dipole-free substance. This theory is now applied to the calculation of the true dipole moments of liquids. H. H. Ho.

3007. Dipole Moments by the Molecular Ray Method. H. Scheffers. *Phys. Zeits.* 35. *pp.* 425–433, *June* 1, 1934.—The molecular ray method has been adapted to the determination of electrical dipole moments [see also Abstract 2624 (1933)], whereby the values of $6 \cdot 8 \times 10^{-18}$, $6 \cdot 3 \times 10^{-18}$, and $4 \cdot 9 \times 10^{-18}$ e.s.u. for KI, KCl, and NaI respectively have been obtained with an uncertainty of less than 5 %. H. H. Ho.

3008. Analysis of Dipole Moments of Aromatic Compounds. G. M. Bennett and S. Glasstone. *Roy. Soc., Proc.* 145. *pp.* 71–80, *June* 2, 1934.—The data for the dipole moments of *para*-substituted anisoles, phenols, diphenyl ethers, and anilines have been analysed by a direct method. The conclusion is reached that in all these substances a deviation Δ from strict additivity of the bond moments occurs. The values of Δ, which is an additional moment operating along the axis of the benzene nucelus, are consistent with those to be expected from the point of view of the electronic theory of aromatic reactivity, and may be regarded as due to the " mesomeric " effect in such substances. The use which has been made of the dipole moments of aromatic compounds for the computation of the valency angle of oxygen (and by implication of sulphur) is shown to be unsound. AUTHORS.

3009. Ethyl Ether as Solvent in Electric Moment Studies. K. Higasi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 499. *pp.* 57–78, *May,* 1934. *In English.*—A discussion is given of the necessary conditions which ethyl ether must satisfy as a solvent for the study of electric moments. Measurements are included for 16 substances and the dependence of the moments upon temperature also studied for 3 of them. The moments of alcohol in ether solution are found to follow closely the rule of the constancy of the alcohol moments in other solutions. The polarisation-concentration curves of alcohols in ether show no maximum, and the moment of ethyl alcohol is found to be almost independent of temperature. Both facts appear to depend upon the decrease of association of the solute molecules in ether as compared with association in non-polar solvents. Decrease in electric moment was observed for solutes like toluene, acetone and nitrobenzene, and is discussed in comparison with Müller's results on them in non-polar solvents. Electric moments of iodine and 1 : 2-dichloroethane have been measured in ether solution and their relation to the nature of the solvent is discussed, whilst the dependence of the moments of ethylene glycol and acetic acid upon temperature is explained. It is concluded that ethyl ether can not only be employed as a solvent for electric moment studies but is even a suitable solvent for abnormal molecules like the alcohols. H. H. Ho.

3010. Discontinuous Increases of Current in Insulators by Very High Fields. R. Schulze. *Ann. d. Physik,* 19. 8. *pp.* 878–890, *May,* 1934.—The insulators sulphur and solid argon were brought in thin layers into extremely high fields (10^9 volt/cm.) and the current flowing through them measured. Thus discontinuous increases of current were found to occur in fields the magnitudes of which in many cases stand in the same numerical relation as the ionisation tensions of the same element. The results show that high fields can act in some way or other directly upon atoms. J. J. S.

3011. Influence of the Electron Current on the Dielectric Rigidity of Crystals. A. Walther and L. Inge. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. 2. *pp.* 65–71, 1934. *In German.*—In order to study the influence of electron concentration with various polarity experiments were made with a strong inhomogeneous electric field and plates of rock-salt were fixed between a point and a plate, the whole system being immersed in tri-cresyl phosphate and the effects of discharge observed. The results show that there is little probability that collision ionisation lies at the basis of the disruption of solid insulators, and the disruption can simply be explained by a detachment of the electrons by the electric field. It is most probable that the electrons originate from the electrodes as previously suggested by Rosenkewitsch. J. J. S.

3012. Absorption Measurements in Liquids in the Region of Short Electric Waves. Part III. J. Malsch. *Ann. d. Physik*, 20. 1. *pp.* 33–56, *May*, 1934.—An absolute method has been developed for the measurement of the optical constants (refractive and absorption indices) for 1 m. and 1 cm. waves, by which means the constants have been evaluated from two simultaneous measurements. The method is applied to butyl alcohol for a wave-length of 180 cm., and, in connection with other measurements in the region of 50–5000 cm., it is shown that the behaviour of this alcohol may be quantitatively explained on the dipole theory of Debye, without resort to the assumption of specific oscillations. [For Part II see Abstract 2630 (1934).] H. H. Ho.

3013. Nature of Capacity of Electrode with A.C. N. Thon. *Comptes Rendus*, 198. *pp.* 1681–1683, *May* 7, 1934.—A theoretical explanation is given of the varying relations between C and ω experimentally arrived at [see Abstract 2167 (1934)] based on the assumption that the passage layer, electrolyte-electrode, consists of a capacity C $(=K/\text{cm.}^2)$ occupying the fraction α of the surface, and of a conducting portion thereof $(1-\alpha)$ the resistance of which is $r = \rho l\,(1-\alpha)$, where ρ is the resistivity and l the thickness of the double layer. The more polarisable the electrode is the greater are α, C, and r, and for perfect polarisability $\alpha = 1$, $C = K$, and $r = \infty$, while for perfect reversibility $\alpha = 0$, $C = 0$, and $r = \rho l$. The capacity C′ as measured by a Wheatstone Bridge $= 1/\omega^2 r^2 C + C$, being $1/\omega^2 r^2 C$ for an unpolarisable electrode, whence for any such system, r and C being constant, $C' \propto 1/\omega^2$, but as a lower power of $1/\omega$ as the electrode is more polarised; thus for the system $Ag/AgNO_3$ $C' \propto 1/\omega^{\frac{1}{2}}$ approximately. Similarly the measured resistance differs very little from the true resistance of the electrolyte with a reversible electrode, but the difference increases as the electrode is more polarisable. C. A. S.

See also Abstract 3030.

ELECTROCHEMISTRY.

3014. Oxido-Reduction at Membrane in Cupric Solution, during Electrolysis. Lina Guastalla. *Comptes Rendus*, 198. *pp.* 1679–1680, *May* 7, 1934.—The membrane was stretched across the lower end of a vertical tube plunged in a crystallising dish containing a cupric solution. The normal operating conditions were: potential, 800 volts; current density, 5mA/cm.^{2}; temperature, 10° to 15° C. Membranes of pig's bladder, soaked in alcohol for a long time, were used. In electrolysis of cupric chloride, on the face of the membrane turned towards the anode, a blue deposit of cupric oxychloride is formed very rapidly, after which appears a blackish brown precipitate of CuO containing a small proportion of Cu_2O and finally metallic copper. Experimental investigation shows that the thickness of the zone in which the oxides and the metal are precipitated is, under the conditions obtaining, of the order of 0·02 or 0·03 mm. Certain physical variations of the membrane, acidification of the solution, or the use of a lower voltage, give the oxychloride precipitate a gelatinous nature and the processes of oxido-reduction are retarded. A. W.

3015. Influence of High Concentrations of Electrolyte on the Deposition Potential of Polonium. M. Guillot and M. Haïssinsky. *Comptes Rendus*, 198. *pp.* 1758–1760, *May* 14, 1934.—HNO_3 at concentrations up to 4*N* does not influence the deposition potential of polonium on gold (+ 0·37 volt against the normal calomel electrode), but H_2SO_4 depresses the potential, which falls to + 0·10 volt in 4*N* acid; in relatively dilute acetic acid low values are obtained, *e.g.*, + 0·24 volt at 1·12*N*. Addition of the sodium salt of the acid used further depresses the potential even to negative values, sulphate having a greater effect than nitrate. Potassium ferrocyanide and ferricyanide inhibit deposition completely. Polonium may be deposited in neutral solution in presence of salts at sufficiently high concentration, *e.g.*, in 3·5 *N* sodium nitrate at + 0·13 volt, and in 2·3 *N* potassium sulphate at + 0·25 volt. The theory underlying these results is obscure. H. F. G.

3016. Glass Electrode. B. Lengyel and E. Blum. *Faraday Soc., Trans.* 30. *pp.* 461–471, *June*, 1934.—Glass electrodes have been examined to determine the effect of their chemical composition upon their electrometric properties in various solutions. The hard-glass type reacts to H-ions. Addition of 10 % of B_2O_3 or Al_2O_3 renders the electrode susceptible also to Na ions. A. S. C. L.

3017. Photographic Record of Chemical Reactions. G. Fouretier. *Comptes Rendus*, 198. *pp.* 1689–1691, *May* 7, 1934.—The reagent is added at a definite rate by means of a mechanical device, and conductivity and pH plotted photographically against that amount by means of suitably arranged galvanometers. The apparatus is figured, and its use exemplified by application to the interaction of 0·1 *N* KOH and 0·0025 *M* $H_4P_2O_7$. [See Abstract 3050 (1932).] C. A. S.

3018. Theory of Acids and Bases and of Protolytic Solvents. J. N. Brönsted. *Zeits. f. phys. Chem.* 169. *Abt.A.* 1–2. *pp.* 52–74, 1934.—The function common to acids and bases consists in a migration of the proton; these compounds are hence named protolytes and their reaction protolysis. The acidity or basicity—termed the protolytic state—of a system is defined with the aid of the thermodynamic activity, the presence of H-ions not being essential for the practical definition of this state. The acidic and basic properties of protolytes are best expressed by the acidity and basicity constants, and the dependence of these on the type of charge and on the medium is considered. Every protolytic reaction is a special case of the common process proceeding between two pairs of corresponding acids and bases, and the corresponding protolysis constant is expressed as the product of the potential strength constants of the reacting acid and base. The electrolytic dissociation of pure solvents is termed autoprotolysis and occurs only in amphiprotic media, while that of dissolved acids and bases is conditioned by the protolytic properties of the medium. T. H. P.

3019. Electrochemical Behaviour of the Tin-Iron Couple in Dilute Acids. T. P. Hoar. *Faraday Soc., Trans.* 30. *pp.* 472–482, *June*, 1934.—The reversal of the tin-iron couple e.m.f. in dilute acid solution is shown to be due to solution of the oxide films originally present on the surfaces of both metals. Tin is anodic in dilute solutions of acids, such as citric and oxalic, in which complex formation occurs. In sulphuric acid it is kathodic. Both iron and tin corrode in citric acid; as couple, the tin corrodes more and the iron less owing to the superposed e.m.f. of the couple. This is quantitatively related to the increase of tin and decrease of iron corrosion. Both are reduced by polarisation. The bearing of these results upon the corrosion of tin plate is discussed. A. S. C. L.

See also Abstracts 2679, 2681, 3013.

ELECTRONS, POSITRONS AND PROTONS.

3020. Positrons: Focussing of Beams, Measurement of Charge-to-Mass Ratio, Study of Absorption and Conversion into Light. J. Thibaud. *Phys. Rev.* 45. *pp.* 781–787, *June* 1, 1934.—1. Description of a method (" method of the trochoid ") of concentrating and focussing weak electron beams so that they form strong sharp lines on a photographic plate. 2. Displacement of the beam thus formed by an additional field, enabling the observer to recognise the sign of the charge and to estimate the charge-to-mass ratio of the particles, with an accuracy thus far brought up to 15 %. 3. Absorption, in thin films of platinum and a large number of other elements, of the positive and negative electrons proceeding from a source composed of a radioactive substance emitting strong γ-rays and enclosed in lead; it is shown that the absorption follows an exponential law over a wide range of thicknesses, and the value of the mass absorption-coefficient is obtained from observations on the imprint made upon a photographic plate behind the absorber. 4. When in the foregoing experiments the thickness of the absorber is increased beyond about 500 $mg./cm.^2$, it becomes evident that the imprint on the plate is partly due to something else than the transmitted electrons. This " something else " is considered to be radiation; with negative electrons it consists entirely of secondary γ-rays, with positrons there is an additional component ascribed to the merging of positive with negative electrons and their conversion into photons. 5. The absorption-coefficient of these photons implies that their energy is about 0·5 MEV, and the intensity of the radiation implies that there are about two of them per positron—two results which agree well with Dirac's theory. 6. Positrons have also been observed in conditions where it seems that they proceed directly from radioactive substances. AUTHOR.

3021. Energy Spectrum of Positrons from Al. Lise Meitner. *Naturwiss.* 22. *pp.* 388–390, *June* 1, 1934.—The velocity spectrum of the positrons emitted by Al (100 μ thick) under bombardment of Po α-particles was obtained by means of stereoscopic Wilson chamber photographs taken in a magnetic field. The results indicate a continuous spectrum, the high energy limit of which is about 2×10^6 volt, the maximum occurring between 8×10^5 and 1×10^6 volt. Experiments with thinner Al foil (27 μ) give similar results. W. E. P.

3022. Zero Angle Energy Losses in Helium. R. L. Womer. *Phys. Rev.* 45. *pp.* 689–693, *May* 15, 1934.—Inelastic electron scattering at 0° has been studied in helium with an electrostatic analyser. Below 100 volts, four energy losses have been identified and studied: the $1^1S - 2^1P$, $1^1S - 3^1P$, $1^1S - 2^1S$, and $1^1S - 2^3S$. The probabilities of these losses relative to the $1^1S - 2^1P$ loss have been determined, and these ratios compared with theoretical values. The ratio for the $1^1S - 3^1P$ is in good agreement with theory; that for the $1^1S - 2^1S$ is not. The relative probability of the $1^1S - 2^1P$ loss has been measured from 50–150 volts. It exhibits a maximum at 75 volts and a rapid decrease down to 40 volts. Above 100 volts it is in general agreement with other experimental results. AUTHOR.

3023. Electron Deflection at "Crossed-Lattice" Powders. A. Steinheil. *Zeits. f. Physik,* 89. 1–2. *pp.* 50–57, *May* 15, 1934.—When fast electrons undergo deflection by an irregularly oriented mass of small crystals which when single yield "crossed-lattice" spectra, the majority of the principal lines coincide with the "crossed-lattice" spectrum, but the intensities of the weak lines are not in accordance therewith. Calculation shows that superposition of the space and "crossed-lattice" interference occurs. The bearing of this result on analogous work with protons is discussed. H. F. G.

3024. Inner Potential of Crystals. S. Kikuchi and S. Nakagawa. *Zeits. f. Physik,* 88. 11–12. *pp.* 757–762, *May* 5, 1934.—The experiments of Yamaguti [see Abstract 2186 (1934)] on the determination of the inner potential of crystals by the reflection of electrons, are extended to electrons of energies between 50 and 90 e-kV. Yamaguti's conclusions that the inner potential is apparently lower for lower order reflections are confirmed using a molybdenite crystal. A graph shews that the inner potential assumes a constant value for higher orders of reflection; the behaviour is independent of the wave-length of the electrons used. Similar results are obtained with zinc blende. Two explanations are possible. The first, which is less satisfactory, is to suppose that the structure of the upper atomic layers is different from those lying deeper and that this difference becomes effective when the glancing angle is small. Alternatively it may be supposed that the Bragg formula is inapplicable at small glancing angles and that the concept of inner potential becomes indefinite under these conditions. F. C. C.

3025. Electron Diffraction Camera. W. G. Burgers and J. C. M. Basart. *Physica,* 1. *pp.* 543–548, *May,* 1934. *In English.*—A description is given of an apparatus for the diffraction of electrons of medium velocity (30–50 kV), adapted to both the transition and reflection methods. Films prepared by evaporation within the apparatus itself, and the influence of heat on them, can be investigated. AUTHORS.

3026. Electron Diffraction by the Oxides of Nitrogen. L. R. Maxwell, V. M. Mosley and Lola S. Deming. *J. Chem. Phys.* 2. *pp.* 331–336, *June,* 1934.—Electron diffraction has been obtained by the transmission of electrons (20–35 kV) through molecular beams of N_2O, NO_2, N_2O_4 and N_2O_5. The molecular structure determinations were made by using the complete electron scattering formula including the incoherent scattering. The results can be summarised as follows: (1) *Nitrous oxide*; for a linear model the separation of the end atoms was found to be 2·38 ± 0·05 Å in exact agreement with Wierl's measurement on this structure. Unfortunately it is impracticable to distinguish between models of the form N — O — N and N — N — O. (2) *Nitrogen dioxide*; no diffraction rings were observed which is to be expected if the molecule is triangular with the N — O distance 1·15 to 1·3 Å. (3) *Nitrogen tetroxide*; the presence of one diffraction ring at $(1/\lambda) \sin \theta/2 = 0{\cdot}455 \pm 0{\cdot}01$ lead to the conclusion that the N — N distance is 1·6 to 1·7 Å for the model $O_2N - NO_2$. No definite angular relationship between the two planes containing the NO_2 groups could be determined. (4) *Nitrogen pentoxide*; again only one diffraction ring was observed. It occurred at a slightly greater angle than for N_2O_4 giving $(1/\lambda) \sin \theta/2 = 0{\cdot}474 \pm 0{\cdot}004$. The symmetrical model $O_2N - O - NO_2$ with the N — O distance 1·3 to 1·4 Å gave a calculated interference pattern in best agreement with this result. AUTHORS.

3027. Polarisation of Electrons. G. P. Thomson. *Phil. Mag.* 17. *pp.* 1058–1071, *May*, 1934.—For electrons (150 kV) scattered through 90° by a thin or thick film and then diffracted by a thin film no asymmetry in the intensity of the diffraction rings could be detected. In the second experiment the electrons were subjected to two 90° scatterings in a plane and the final scattered intensity was measured (*a*) when the two scatterings were in the same sense; (*b*) when they were in opposite senses. No difference in intensity was observed either for 30 kV or 103 kV electrons. The latter result is at variance with Mott's theory based on the Dirac wave equation of the electron. W. S. S.

3028. Electron Spin. J. Solomon. *J. de Physique et le Radium*, 5. *pp.* 167–170, *April*, 1934.—The possibility of obtaining a completely polarised electron beam, with parallel electron spin, is examined mathematically having regard to the principle of uncertainty and the theory of relativity. N. M. B.

3029. Emission of Electrons under the Influence of Chemical Action. Part III. A. K. Denisoff and O. W. Richardson. *Roy. Soc., Proc.* 145. *pp.* 18–51, *June* 2, 1934.—Characteristic energy distribution curves, and other data are given for the electrons emitted when NaK_2 is acted on by Cl_2, NOCl, $COCl_2$, Br_2, I_2, and COS at very low pressures. With HCl and H_2O the emission is small but probably real, with N_2O very small and probably zero. For N_2O there was no evidence of chemical action. Current and pressure curves are given for Cl_2, NOCl, and COS and current and time curves for Cl_2. The data are discussed, and analysed, in the light of the theory of the electron emission mechanism developed in Part II [see Abstract 1723 (1934)] and found to be consistent with it. In particular the measured maximum electron energies are found to be equal to the differences between the chemical energy available in the reaction and the work function of the alloy, provided the reactions with Cl_2, NOCl, and $COCl_2$ go to a great extent in one stage, and those with Br_2 and I_2 go mainly in two stages. With the reactions which involve oxygen and sulphur either ambiguities in the interpretation or gaps in the data make similar simple statements impossible. The electron yields are given and shown to be high for energetic and low for weak reactions. For homologous reactions the electron yield is a sensitive function of the energy available. AUTHORS.

See also Abstracts 2689, 2705, 2765, 2874, 2875, 2876, 2984.

ELECTROSTATICS.

3030. Electrification of Two Non-Parallel Discs. D. P. Banerjee. *Indian Phys.-Math., J.* 5. *pp.* 21–24, *April,* 1934.—Nicholson [see Abstract 1306 (1925)] solved the problem of the electrification of two co-axial discs; the author considers the case of two which are equally charged and non-parallel. The working involves a transformation of spherical harmonics to a new origin and a new set of axes; a convergent series for $I_m^n(x)$, and an alternative value for the same; application to two equal and equally charged non-co-axial circles. A. D.

See also Abstracts 2780, 3001.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

3031. Discontinuities in the Magnetic Resistance in Ferromagnetism. G. Alocco and A. Drigo. *N. Cimento,* 11. *pp.* 224–226, *April,* 1934.—Considering the discontinuities of resistance found by Heaps [see Abstract 1726 (1934)] in nickel wire magnetised longitudinally, it is shown that facts are not in favour of its being connected with the Barkhausen effect, but that it results from electromagnetic induction due to a cycle of magnetisation in a twisted wire. H. M. B.

3032. Theory of Change of Resistance in a Magnetic Field. H. Jones and C. Zener. *Roy. Soc., Proc.* 145. *pp.* 268–277, *June* 2, 1934.—The theory of the change of resistance of a metal in a magnetic field is developed for an arbitrary lattice, with the single assumption of a constant time between collisions for electrons at all points on the surface of the Fermi distribution. The theory is applied to Li, with excellent agreement with experiment. AUTHORS.

See also Abstract 2938.

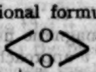
MAGNETISM AND ELECTROMAGNETISM.

3033. Electric Resistance and Ferromagnetism. N. Tunazima. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 151–159, *April,* 1934. *In German.*—The resistance of ferromagnetic bodies has been related to their spontaneous magnetisation by the empirical formula $R = R_1 + C\,(n^2 - m^2)$, where R_1 represents the part also present in non-ferromagnetic bodies, and the second term depends on the Weiss field; n and m are the Weiss fields at zero and the given temperature respectively, and c is a constant depending on the substance. A mathematical proof of the above formula is presented. G. E. A.

3034. Magnetisation Curves with Superposed A.C. Field and Coercive Force of Thin Films of Iron. S. Procopiu. *J. de Physique et le Radium,* 5. *pp.* 199–206, *May,* 1934.—The shape of the curves connecting intensity of magnetisation for a fixed d. c. field with amplitude of superposed a. c. field [see Abstract 1385 (1931)] is explained in terms of irreversible reversals and reversible rotations of the elementary magnetic particles and of a Maxwellian distribution of coercive force for the particles. Formulæ for the curves are derived and the influence of high frequency is shown to be explicable by "skin effect." The a. c. field at which the magnetisation occurs provides a measure of the coercive force. This method of measurement is applied to thin films of electrolytically deposited iron, and previous results, showing a continuous increase of coercive force with decreasing thickness without the occurrence of critical values, are confirmed down to 47 $m\mu$. Observations on films a few microns thick establish the existence of thin superficial layers of much higher coercive force than the rest of the film. C. E. W.

3035. Variation of Magnetic Saturation at Low Temperatures. P. Weiss. *Comptes Rendus,* 198. *pp.* 1893–1895, *May* 28, 1934.—For temperatures down to that of liquid air it has been shown that $\sigma = \sigma_0 (1 - AT^2)$, where σ is the magnetisation at saturation at a temperature T, σ_0 the absolute saturation value and A a constant. This law applies to Fe and Ni. Bloch has deduced the law (from Heisenberg's theory) $\sigma = \sigma_0 (1 - BT^{3/2})$. Further experiments are described in which the magnetisation is measured down to 20° K. The T^2 law is accurate for temperatures down to 90° K, but below that temperature deviations are observed; over the range 90° to 20° K the $T^{3/2}$ law holds. H. J. H. S.

3036. Transformations of Pyrrhotite and Ferrous Sulphide. A. Michel and G. Chaudron. *Comptes Rendus,* 198. *pp.* 1913–1915, *May* 28, 1934.—Thermomagnetic curves of pyrrhotite (FeS + 1·6 % S) indicate that ordinary (metastable) pyrrhotite with unit cell *a* 3·41 × *c* 5·72 Å, above 200° passes rapidly into the ferromagnetic variety (*a* 3·47 × *c* 5·84 Å), and this at 450° reverts to the metastable variety (*a* 3·40 × 5·70 Å). Precipitated FeS behaves very similarly, save that if heated above 480° it passes irreversibly into a non-magnetic variety with unit cell *a* 3·36 × *c* 5·65 Å. C. A. S.

3037. Ferromagnetism and Structure of Ferrous Ferrite. A. Krause. *Zeits. f. phys. Chem.* 26. *Abt.B.* 1–2. *pp.* 58–62, 1934.—For this compound a constitutional formula is suggested, containing special iron-oxygen linkings, — Fe  Fe —, which are regarded as characteristic of ferromagnetic iron-oxygen compounds. The evidence in favour of this constitution is considered. T. H. P.

3038. Magnetic Viscosity. A. Mitkevitčh. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 1. 9. *pp.* 534–537, 1934. *In English.*—Magnetic viscosity is defined and the conditions favourable to its appearance are examined on the basis of configurations of elementary magnets. Experiments are described in which the magnetic viscosity of thin iron wire (0·1 mm. dia.) has been studied for periods up to 30 min. after change in the magnetic force for fields of 5 and 80 G. H. J. H. S.

3039. Magnetic Anisotropy in Cobaltammine Crystals. L. W. Strock. *Zeits. f. Krist.* 88. *pp.* 238–247, *June,* 1934. *In English.*—Cobaltammine crystals of known habit and optical properties were immersed in an equal-density liquid of acetylenetetrabromide and benzene. While so immersed, the direction which the crystal placed parallel with the lines of force in a magnetic field was noted. This orientation was vigorous for most of the pentammine and tetrammine cobalti-salts investigated, so that they exhibit strong magnetic anisotropy, as well as strong optical anisotropy. The direction of largest (algebraic) magnetic susceptibility (χ_1) orientates parallel with a magnetic field, by which means this direction was determined in 17 different crystals. Previously unpublished optical data are given for the dichromate, chlorate, and perchlorate of the oxalato-cobalti-tetrammine series, for chlorpentammine cobalti-chloride and perchlorate, and for nitropentammine cobalti-nitrate-chloride. AUTHOR.

3040. Magnetic Properties of Lanthanum, Cerium and Neodymium. F. Trombe. *Comptes Rendus,* 198. *pp.* 1591–1593, *April* 30, 1934.—The metals were tested at 16° C. in different fields, and the values found for $\chi \cdot 10^6$ at 3000 gauss were: La 1·21, Ce 17·94, Nd 39·48. The susceptibility of La and Ce diminishes slightly with stronger fields; that of Nd is practically constant. Curves of the variation of $1/\chi$ with temperature show that Ce appears in two states between 100° K. and 200° K.; La is feebly paramagnetic and becomes weaker with rise of temperature; Ne has a moment of 11·3 Weiss magnetons from 90° K. to 109° K. and 17·8 magnetons from 109° K. upwards. G. E. A.

3041. Magnetic Phenomenon in Alloys. R. Forrer and (Miss) A. Serres. *Comptes Rendus*, 198. *pp.* 1903–1905, *May* 28, 1934.—A study is made of alloys which have no magnetic moment but which show the same thermal behaviour as ferromagnetic bodies at temperatures near the Curie point. Below the "Curie point" of the alloy the diamagnetism is constant but above this point the diamagnetism decreases almost linearly with temperature. This phenomenon may be due to an increasing degree of paramagnetism superposed on a constant degree of diamagnetism; the experimental evidence in support of this view is briefly described. [See also Abstract 5453 (1933).] H. J. H. S.

3042. Magneto-Chemistry of Rhenium. N. Perakis and L. Capatos. *Comptes Rendus*, 198. *pp.* 1905–1907, *May* 28, 1934.—The magnetic susceptibility of metallic Re, of Re_2O_7 and of a number of salts containing Re in the heptavalent state have been measured and the results are briefly described. H. J. H. S.

3043. Relation between the Motion of Electric Charges and Wave Propagation. F. Prunier. *R.G.E.* 35. *pp.* 559–566, *April* 28, 1934.—The author shows that the electromagnetic field generated by a charge moving rectilinearly with a velocity v approaching that of light, tends to coincide with the field in a plane light wave of very high (theoretically infinite) frequency. Starting from this correspondence and admitting that v is in fact not equal to c, a derivation of the wave equation (Schrödinger form) is obtained. The connection of the ideas here given with Dirac's equation is discussed. W. S. S.

3044. Electromagnetic Theory. H. Bateman. *Phys. Rev.* 45. *pp.* 721–723, *May* 15, 1934.—The electromagnetic equations may be derived from a variational principle by expressing the field in terms of the scalar parameters of a number of constituent fields each of which can be described by means of moving lines of magnetic induction. One set of field equations is then satisfied identically and the other set is derived from the variational principle by varying independently the parameters of all the constituent fields. The advantage of the use of scalar parameters is that the stress tensor occurring in the laws of conservation may be obtained by means of a simplified form of Schrödinger's rule. The method is extended to the case in which the Lagrangian function is an arbitrary function of two relativistic invariants and some remarks are made on Born's new electrodynamics. [See Abstract 1875 (1934).] AUTHOR.

3045. Torsional Magneto-Elastic Effects. R. Becker and M. Kornetzki. *Zeits. f. Physik*, 88. 9–10. *pp.* 634–646, *May* 2, 1934.—Experiments on annealed iron and nickel wires are described, which were designed to demonstrate simply some magneto-elastic effects to be expected theoretically, rather than to provide methods of precision-measurement. The chief observations made are: (1) When the wires are twisted and released a residual twist is obtained, which increases at first with the initial twist applied but finally approaches a saturation value. It can be removed by applying a longitudinal magnetic field or

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an a.c. demagnetisation. With a still larger initial twist a genuine plastic residual twist occurs which cannot be similarly removed. (2) The maximum residual twist agrees closely with that produced by a spiral magnetic field (Wiedemann effect). (3) Curves connecting applied torque with resulting twist show marked hysteresis, which is almost entirely suppressed by applying a longitudinal field of 100 oersteds. (4) The damping of torsional oscillations in the wires is reduced to about a tenth by applying a similar field. All these effects on the purely mechanical properties of the materials are explained by the change of direction of the spontaneous magnetisation produced by external mechanical forces. C. E. W.

3046. Auxiliary Coil for Large Bellevue Electromagnet. A. Cotton and T. Belling. *Comptes Rendus,* 198. *pp.* 1645–1649, *May* 7, 1934.—Describes the construction and use of a coil formed of copper tubing which carries large currents and also acts as a water-cooling system. The coil is an auxiliary to the Bellevue electromagnet [see Abstract 2795 (1930)] and fits into the pole-gap. With 400 A in the electromagnet and 3500 A in the auxiliary coil, a field of 60200 gauss is obtained. G. E. A.

3047. Simple Eddy-Current Apparatus for Measuring Magnetic Field-Strength. H. Buchner. *Phys. Zeits.* 35. *pp.* 409–410, *May* 15, 1934.—An apparatus for making very localised measurements of magnetic field-strength is described, which is less inconstant and fragile than the bismuth-spiral. A spindle carrying a small aluminium cylinder at one end is mounted on pivots so that it can be twisted against the torque of a light spiral spring and held by the pressure of a flat spring. By means of a photographic automatic release mechanism the spindle is then released for a definite period and the angle turned through under the action of the spiral spring depends on the eddy-current braking applied to the cylinder and hence is a measure of the field in which it is placed. Temperature effects are largely self-compensatory and an accuracy of the order of 2 % is claimed. C. E. W.

3048. Measurement of Intensity of Magnetic Fields. H. S. Jones. *Rev. Sci. Instruments,* 5. *pp.* 211–214, *June,* 1934.—The current in a small spring-suspended coil, placed in the field to be measured, is adjusted to give a fixed angle of deflection, the coil in its deflected position being parallel to the field. The current required is inversely proportional to the field, but to avoid a hyperbolic calibration curve, the coil is fed through a resistance network so designed that the resistance of one branch varies linearly with H and hence can be calibrated to give a linear scale of H. Three ranges, *viz.,* 10–100, 100–1000, 1000–10000 gauss [oersteds] are provided by using 3 sets of values for two other branches of the network. The instrument is restricted to use in gaseous media and in spaces of section not less than about 2 cm. square. Above H = 1000 also the magnetic properties of the brass housing cause disturbances unless the material is selected with great care. C. E. W.

3049. Automatic Magnetic Field Stabiliser of High Sensitivity. C. E. Wynn-Williams. *Roy. Soc., Proc.* 145. *pp.* 250–257, *June* 2, 1934.—A method is described whereby the field of an electromagnet is kept automatically constant to at least 1 part in 50,000. No matter what the cause of field fluctuation may be the stabiliser readjusts the exciting current until the field is brought back to its original value. The stabiliser may also be used (1) to increase or decrease the field by any desired amount and to maintain the field at its new value, (2) to maintain a steady current or a

p. d. Light reflected from the mirror of a fluxmeter is incident upon a double kathode photoelectric cell, each kathode of which is connected through the medium of an extremely simple valve and thyratron circuit to a system of relays. Movement of the light actuates the relays, causing an electric motor rapidly to readjust the magnet current. Several possible photoelectric cell and thyratron circuits were tried and the best is described in detail. F. C. C.

See also Abstracts 2753, 2754, 2991, 2993, 3068.

MEDICAL RADIOLOGY AND ELECTROLOGY.

3050. Tissue Structure and Heating Effects of Short Waves. M. Jellinek. *Comptes Rendus,* 198. *pp.* 1723–1724, *May* 7, 1934.—The effects of electromagnetic waves of 3 m. length on a number of biological objects of similar physicochemical structure, dielectric constant, etc., are examined. It is suggested that, in the resultant heating effects, a number of hitherto neglected conditions, such as tissue structure and the presence of air spaces, are involved. J. E. R.

3051. Spectrophotometric Analysis of the Colour of the Skin after Irradiation by Ultra-Violet Rays. J. R. Rogin and C. Sheard. *Radiology,* 22. *pp.* 577–588, *May,* 1934.—Spectrophotometric analysis is used to determine the degree of coloration of the erythema of the skins of human patients, after irradiation by X-rays, and is now applied in respect to ultra-violet rays. The paper is largely a discussion of the experimental curves so obtained, which show that the initial reaction may be of a peaked, flat, or double-peaked type, persisting, in a rhythmic or wave-type variation, for several weeks. The amount of pigmentation after ultra-violet irradiation, is directly proportional to the degree of the preceding erythema, in the same subject, but cannot be used for comparison between different subjects. Pigmentation follows a rhythmic course, independent of the erythema, but there is marked individual variation in their periodicity. The fundamental dominant wave-length of the skin of ultra-violet irradiation, remains constant, and changes of redness of the skin are due to changes of purity of the radiating source. B. J. L.

3052. 600 kV X-Ray Therapy. S. G. Mudd, C. K. Emery, O. M. Meland and W. E. Costolow. *Am. J. of Roentgenology & Radium Therapy,* 31. *pp.* 520–531, *April,* 1934.—Reference is made to high-voltage X-ray installations in New York and Berlin. Lauritsen and his co-workers installed in 1931 in California an installation to operate at 600 kV, which was, in 1933, increased in voltage to 750 kV and, still more recently, to 1000 kV. The X-ray tube is operated in connection with high-vacua exhausting plant. At 600 kV the short-wave length limit, after filtration via 5 mm. steel is 0·02 Å, and the effective wave-length 0·04 Å. Operated at 750 kV and similar filtration, the wave-length limits are 0·016 Å and 0·024 Å respectively and, at 1000 kV, 0·012 Å and 0·018 Å. Illustrations are given of the equipment, but the paper is generally medical in respect to the results of three years work in treating 285 cancer patients at 600 kV. Many cases of palliation have been observed and the authors are of opinion the results obtained are superior to those obtained by lower voltage installations and compare favourably with the results obtained by a 4 gm. radium pack. B. J. L.

3053. Present Status of X-Ray Therapy with Voltages above 200 kV. T. Leucutia and K. E. Corrigan. *Am. J. of Roentgenology & Radium Therapy,* 31. *pp.* 628–662, *May,* 1934.—A comprehensive review on modern high voltage X-ray work in the U.S.A., in the region of 1000 kV. The design of X-ray tubes for such operation is first discussed. In this direction details are given of the two-sectioned cascaded glass tube of Coolidge, directly operated upon a vacuum pump, and of the Lauritsen tube of porcelain, which, with an overall length of 31 feet, is operated, with pump connection, at 1100 kV, a similar type of tube for operation at 500 kV having a length of 7 feet. Fairly complete details are given of the construction. For the operation of these high voltage tubes, Coolidge has employed induction-coil operation between 600 and 900 kV. The Lauritsen tube is operated by a cascade transformer. Reference is made to operation of similar voltage tubes with d. c. constant potential. More novel methods of excitation are by means of the Villard and Witka connections and details are given of the Sloan radio oscillator h.t. generator, which has been operated in the University of California at 800 kV, this apparatus employing high-frequency in connection with a valve resonating transformer circuit. For this latter apparatus it is claimed that it is compact, inexpensive, rugged and no high voltage exists outside the vacuous space in which it is developed. Two other methods which have been utilised for research in connection with atomic nuclear disintegration are described, one the " shock-voltage " apparatus of Brasch and Lange and the other the static machine of van de Graaff, which allow the production of voltages of 7000 and 10000 kV, the former employing the discharge of a bank of condensers, and the latter being a friction machine of a special type. Further, Lawrence and Livingstone have employed apparatus in which the necessary velocity of the electrons is obtained by means of an oscillating electric field and an adjusting magnetic field, with which neutronic rays have been obtained. In the medical applications of such high voltages, fresh considerations arise in respect to protection and measurement of the radiation. In the latter relationship, methods of determining the quality of the radiation by means of the spectrometer, by absorption and by voltage measurements are discussed, together with the measurement of quantity of radiation, the depth dose, scattering, etc., the Compton effect, having to be considered. The quality of the radiation is expressed in terms of equivalent volts, as calculated from absorption curves of aluminium and water. Dosage is calculated in skin erythema doses, in relation to the number of röntgens necessary. The use of such h. t. apparatus for clinical purposes will undoubtedly result in advancement of the X-ray treatment of cancer, since results have been obtained where the more usual 200 kV apparatus had failed. B. J. L.

3054. Wave-Length Variation in X-Ray Dosage. M. C. Reinhard. *Am. J. of Roentgenology & Radium Therapy*, 31. *pp.* 538–540, *April*, 1934.—In X-ray therapy, increase of penetration results in less absorption per unit volume, and, in order to obtain equal skin reaction or tolerance, the applied dosage must be increased. The present paper briefly discusses this variation, in respect to curves obtained experimentally. B. J. L.

3055. X-Ray Dosage. A. Rogozinsky. *J. de Radiologie at d'Electrologie*, **18**. *pp.* **220–229**, *May*, **1934**.—In the measurement of X-ray intensity, or dosage, by means of the ionisation chamber, error can arise if the amount of radiation absorbed is negligible, or the absorption of the gas is weak. The author introduces the consideration of a " local dose." for each point in space within the ionisation chamber. This local dose is discussed and defined analytically, and conclusions are given as to the use of a chamber having a large window, to obviate the errors of secondary radiation and the utility of determining the local dose. B. J. L.

3056. X-Ray Depth Doses, Striking at Angles other than 90°, Measured in a Water Phantom. E. A. May. *Radiology*, **22.** *pp.* 559–568, *May*, 1934.—Isodose charts, *i.e.*, charts of X-ray dosage at different depths, are normally based on the fact that the tube is directly overhead, so that the incident beam of X-rays upon the patient is at an angle of 90°. If the tube is inclined the isodose curves become distorted. It is found that it is uneconomical to apply the tube at an angle less than 45°. The isodose chart which has a flat bottom is discarded in favour of the chart having a bottom curved at the edges, since this compromises the errors due to the differences in distance between the tube focus and the mid-point and edges of the field, when treatments are given at an angle. In actual treatment, these differences may necessitate a 5 to 10 % increase in dosage. Compression of the patient is advantageous, since it brings the part to be irradiated nearer to the body surface and overcomes distortion due to oblique irradiation. The use of wax, or other absorbent materials, to produce a more homogeneous irradiation, is stated to be disadvantageous, as it results in a smaller depth dosage, although it is of value when a body part of small diameter is to be irradiated with a tangential field, as depth dosage is then materially increased. B. J. L.

3057. Composite X-Ray Filters. A. Mutscheller. *Radiology*, 22. *pp.* 569–576, *May*, 1934.—A paper largely of data, after preliminary discussion of the increase of depth-dosage, by the use of metal filters. One method of increasing the depth-dosage is by the use of more carefully compounded and adjusted composite X-ray fields, employing different metals. It is shown that the direction of the rays *via* such composite filters must be in the order of the metallic atomic weights, beginning with those which have the highest atomic numbers. Results show that composite filters can increase by 10 % the depth-dosage and average absorption beyond that with a single metal (copper) only. Two practical filters for operation at 100 and 200 kV employing aluminium, tin, or a metal of higher atomic weight than tin, are recommended. B. J. L.

3058. Overhead Aerial H.T. System. F. Liberson. *Am. J. of Roentgenology & Radium Therapy*, 31. *pp.* 690–692, *May*, 1934.—Whilst the use of flexible h.t. cable, with earthing of the outer sheath, has obviated, to a large extent, the need of an overhead aerial system, this is still necessary where several pieces of X-ray apparatus have to be operated from a single h.t. unit. The author describes an aerial system in which one rheophore revolves on a trolley around the central rheophore connection, thus obviating the need of dangerous unused aerial connections and giving other advantages. B. J. L.

See also Abstracts 2924, 2931, 2951, 2967, 2968.

OSCILLATIONS.

3059. Operational Treatment of Mechanical and Electrical Problems. A. N. Lowan. *Phil. Mag.* 17. *pp.* 1134–1144, *June*, 1934.—The following problems are considered: (1) Forced vibration of a string with variable cross-section in a medium of constant damping coefficient. (2) Forced vibration of a non-uniformly loaded string *in vacuo*. (3) Electrical oscillations in transmission lines. The treatment is illustrative of the class of physical problems characterised by a partial differential equation of hyperbolic or elliptic type. J. J. S.

See also Abstracts 2758, 2759, 2988.

PHOTOELECTRICITY.

3060. External Photoelectric Effect (Hallwachs) and Chemical Constitution. A. Pochettino. *N. Cimento,* 11. *pp.* 213–223, *April,* 1934.—Certain substances such as benzene derivatives are subjected to ultra-violet radiation from a mercury vapour lamp and a filter giving limits of $\lambda = 2378$ and $\lambda = 2652$. The photoelectric effect thus produced is found to depend on the constitution of the molecule and also the arrangement of the groups within the molecule. H. M. B.

3061. Photosensitivity Curve of Dyed Metal Surfaces. Cécile Stora. *Comptes Rendus,* 198. *pp.* 1763–1765, *May* 14, 1934.—It is reported that any pure metal coated with a film of colouring matter (*e.g.*, eosin, methylene blue) is photosensitive. The sensitivity curve is similar to the absorption curve of the dye, but the maximum is displaced towards the red. Experiments with the dye in different strengths show that the photoelectric effect arises in a very thin layer in contact with the metal, the dye above this merely acting as an absorber. D. H. F.

3062. Metal Contact Photoelectric Cell. J. H. de Boer and W. C. van Geel. *Physica,* 1. *pp.* 449–451, *April,* 1934. *In English.*—It is found that, on illumination, a photoelectric current is obtained with a cell consisting of an alkali metal (or alkaline earth metal) separated from a metal plate by a thin layer of insulating material. The effect consists of a current of electrons from the alkali metal through the insulating layer to the metal plate. Using cæsium separated from zirconium by a layer of zirconium oxide about $0{\cdot}1$ to $1\ \mu$ thick, the photoelectric current obtained without applied voltage is 10^{-6} to 10^{-8} ampere for illumination by a tungsten arc lamp of 100 c.p. at a distance of 50 cm. Similar effects are also observed with the combinations Cs-resin-Ni and Ba-BaO-Ni. Since in the insulating layer the electrons occupy the previously empty running levels, the effect is found to have a short-wave threshold as well as a long-wave threshold. L. A. W.

3063. Blocking Layer Photoelectric Effect and Rectification. W. C. van Geel. *Physica,* 1. *pp.* 531–542, *May,* 1934. *In French.*—An attempt is made to account for the behaviour of the rectifier photoelectric cell in the light of recent theories differentiating between metals, semi-conductors and insulators in terms of permitted and forbidden energy levels. Quantitative considerations are not attempted owing to the lack of numerical data. The application of the theory to various individual phenomena which play a part in the photoelectric and rectifying effects is discussed and difficulties are pointed out. D. H. F.

3064. Blocking-Layer Photoelectric Cells. Part I. G. Liandrat. *J. de Physique et le Radium,* 5. *pp.* 179–183, *April,* 1934.—The characteristics of photoelectric cells with blocking layer and of selenium cells can be most satisfactorily explained if the photo-conducting effect in the blocking layer of the first and in the corresponding limiting layer in the second type of cell be taken into account. A theory, involving the impedance of a system of two blocking layers in series, is developed. [See Abstract 2226 (1934).] J. S. G. T.

3065. Temperature Coefficient of Selenium Blocking-Layer Photoelectric Cell. A. Mittmann. *Zeits. f. Physik*, 88. 5–6. *pp.* 366–371, *April* 3, 1934.—The behaviour of a selenium blocking layer cell is investigated over a temperature range from $-174°$ to $+85°$ C. The illumination being constant, it is found that with rise of temperature the e.m.f. on open circuit falls continuously and almost linearly over the whole range; but that the observed external photoelectric current increases at first, passes through a maximum at about $-20°$ C. and thereafter falls again. This behaviour is discussed in terms of the temperature variations of the resistances involved. It is also noted that in the range $-20°$ to $+85°$ C. the curve of the photoelectric current against temperature is slightly different according as to whether it is determined by progressively heating up or progressively cooling down the cell. This peculiar behaviour is not observed with a Cu_2O cell. L. A. W.

3066. Influence of Polarisation on Electrolytic Selenium Photoelectric Cells. R. Audubert and J. Roulleau. *Comptes Rendus*, 198. *pp.* 1907–1909, *May* 28, 1934.—The electronic nature of the action of light on a Se photo-electrode is confirmed by determining the characteristics of such electrodes (a Pt plate covered with Se and rendered photosensitive by thermal treatment) for various wave-lengths with the chain Pt | Se | 0·01 M H_2SO_4 | KCl (sat. sol.) | Hg_2Cl_2, positive polarisation diminishing positive photopotential. [See Abstracts 2087 (1933) and 2671 (1934).] C. A. S.

3067. Constancy of Selenium Rectifier Photoelectric Cells. L. Bergmann. *Phys. Zeits.* 35. *pp.* 450–452, *June* 1, 1934.—In another paper [see Abstract 1360 (1934)] it was concluded that the selenium rectifier cell was unsuitable for the continuous recording of high intensities on account of a falling-off of sensitivity. The author points out that this effect only occurs above certain limiting intensities which vary with different types and are lower for the more sensitive types. The difficulty can always be overcome by using a grey filter, or a suitably placed diaphragm, which will reduce the intensity by a known amount and take it below the limiting value. If sufficient current is not then obtained, a number of cells could be used in parallel. D. H. F.

3068. New Photoelectric Effect in Cuprous Oxide. I. Kikoin. *Comptes Rendus de l'Acad. des Sciences, U.R.S.S.* 2. 2. *pp.* 71–76, 1934. *In German.*—If on a plate of Cu_2O, placed between the poles of a magnet at the temperature of liquid air, light falls in a direction perpendicular to the field and to the surface of the plate, then there exists in the plate in a direction perpendicular to the field and to the direction of the incident light a potential gradient which depends on the magnetic field. The nature of the electrodes used in measuring the p. d. has no influence. Further quantitative measurements show that the current due to the p. d. which flows through the test piece in the magnetic field is stirctly proportional to the intensity of the incident light. If L is the intensity of the light and H the field strength the current $i = k\mathrm{LH}$ where k is a material constant. If σ_0 is the thermal conductivity and σ_1 the photo-conductivity ($\sigma_1 = \beta\mathrm{L}$) then the p. d. $\mathrm{V} = k\mathrm{L}/(\sigma_0 + \beta\mathrm{L})$. When L is large $\mathrm{V} = k/\beta =$ constant, or a saturation must be observed which agrees with experiment. J. J. S.

See also Abstracts 2758, 2759, 2860, 2885, 2924.

THERMOELECTRICITY.

See Abstract 2703.